Design Engineering

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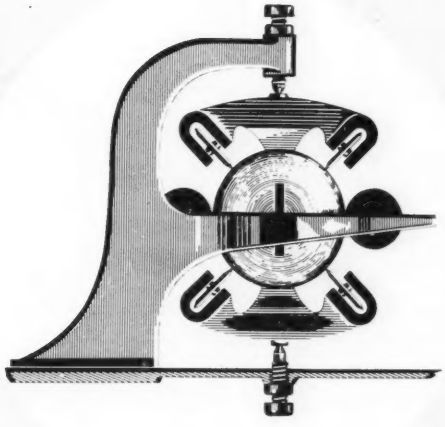

JUNE 1957

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at practical prices!

ALCAN is proud to announce the availability of this new color anodized aluminum sheet, with one side anodized in continuous form. It is an all-Canadian development, offered at far lower cost than has previously been possible with any anodizing process.

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Please send me informative brochure, with samples, giving complete details of your new "COLORCOIL" continuously anodized aluminum sheet.

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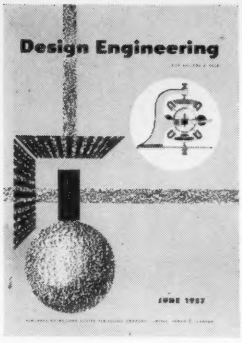

Design Engineering

VOL. 3 JUNE 1957 No. 6

This month's cover

Guaranteed to jump off the desk of any color conscious design engineer and strike him in the eye, the June cover is the work of artist Gerald Bern. Theme of his artwork is Eggleton and Taggart's article on the canny ball resolver. Bern has reduced the device to a few bold shapes and added a woodcut-type drawing of and oldtimer ball resolver to the top right half of the design.

Design Engineering

MEMBER

CCAB

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CONTENTS

Features

Short features

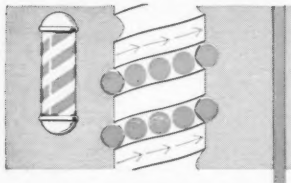
Departments

These MODERN Recirculating Ball Units can help you...

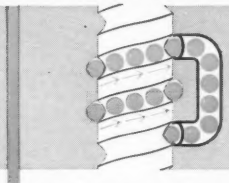
SOLVE ACTUATION and TORQUE PROBLEMS

Saginaw b/b Screws guaranteed 90% efficient —offer 6 major advantages for designers

Available in custom machined and commercial rolled thread types—have been built from 1½ inches to 39½ feet long—⅜ to 10 inches diameter.



Nut *glides* on steel balls. Like stripes on a barber pole, the balls travel toward end of nut through spiral "tunnel" formed by concave threads in both screw and mating nut.



At end of trip, one or more tubular guides lead balls diagonally back across outside of nut to starting point, forming closed circuit through which balls recirculate.

1 VITAL POWER SAVINGS. With guaranteed efficiency of 90%, Saginaw b/b Screws are up to 5 times as efficient as Acme screws, require only ⅕ as much torque. This permits much smaller motors with far less drain on the electrical system. Circuitry is greatly simplified.

2 SPACE/WEIGHT REDUCTION. Saginaw b/b Screws permit use of smaller motors and gear boxes; eliminate pumps, accumulators and piping required by hydraulics. In addition, Saginaw b/b Screws themselves are smaller and lighter. Units have been engineered from 1½ in. to 39½ ft. in length.

3 PRECISE POSITIONING. Machine-ground Saginaw b/b Screws offer a great advantage over hydraulics or pneumatics because a component can be positioned at a predetermined point with precision. Tolerances on position are held within .0006 in./ft. of travel.

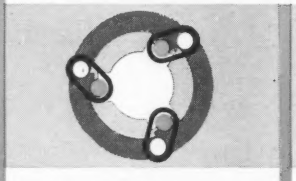
4 TEMPERATURE TOLERANCE. Normal operating range is from −75° to +275° F., but assemblies have been designed in selected materials which function efficiently as high as +900° F. These units are practical where hydraulic fluids have lost efficiency or reached their flash point.

5 LUBRICATION LATITUDE. Even if lubrication fails or cannot originally be provided because of extreme temperatures or other problems, Saginaw b/b Screws will still operate with remarkable efficiency. Saginaw units have been designed, built and qualified for operation without any lubrication.

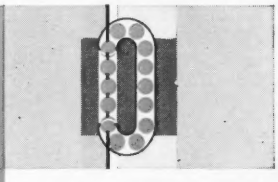
6 FAIL-SAFE PERFORMANCE. Far less vulnerable than hydraulics. In addition, Saginaw offers three significant advantages over other makes: (1) Gothic arch grooves eliminate dirt sensitivity, increase ball life; (2) yoke deflectors and (3) multiple circuits provide added assurance against operating failure.

Saginaw b/b Splines average 40 times lower friction coefficient than sliding splines

Transmit or restrain high torque loads far more efficiently—have been built from 3 inches to 10 feet long—⅜ inch to 6 inches in diameter.



The *Saginaw b/b Spline* radically increases the efficiency of transmitting or restraining high torque loads. Instead of *sliding* against each other, surfaces *glide* on rolling balls.



The steel balls recirculate in closed circuits formed by mating longitudinal raceways spaced around the circumference of inner and outer splines. Guides return balls.

This revolutionary new kind of spline utilizes the same basic principle pioneered by Saginaw in the ball/bearing screw.

It permits new engineering designs never before practical—literally lets you achieve the "impossible"! In any application where column length must change under torque load, the Saginaw b/b Spline offers greatly decreased friction, less wear, longer life, more dependable operation. It can be fitted with integral gears, clutch dogs, bearing and sprocket seats or a wide choice of other attachments for use with electric, hydraulic or pneumatic units. To convert push-pull to rotary motion, helical types are available with very high leads, ranging from 20:1 to 100:1.

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or see our section in Sweet's Product Design File

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General Motors Corporation
b/b Screw and Spline Operation
Dept. 4W, Saginaw, Michigan

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ADDRESS_____

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Saginaw ball bearing Screws and Splines

SAGINAW STEERING GEAR DIVISION OF GENERAL MOTORS

WORLD'S LARGEST PRODUCER OF BALL BEARING SCREWS AND SPLINES

Inside

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In our next issue

Our July issue will be a very special one — Design Engineering's Component Application Guide. Result of Canadian design engineers' request for a handbook of this type, it will carry individual sections of the latest information on all new components and materials and how you can get the best out of them.

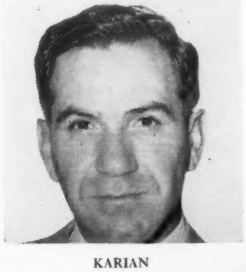
EGGLETON

TAGGART

F. W. Taggart and L. S. Eggleton (Old idea sparks a tiny new calculator) are both with Aviation Electric Ltd. as chief engineer and technical writer respectively. Taggart was a lab technician at Oxford University from '31 to '38, then joined the RAF. He visited Canada in 1940 as an instrument instructor and returned here in 1954 to join Aviation Electric. His spare time is spent in badminton, amateur dramatics, golf and as a shutterbug. Eggleton is also an ex-RAF man because the war broke off his accountancy course. His training led him into electronics in the RAF and he later joined Shell Oil in South America. Since arrival in Canada he has worked with TCA and CGE (at CGE in the writing field). He is in charge of technical publications.

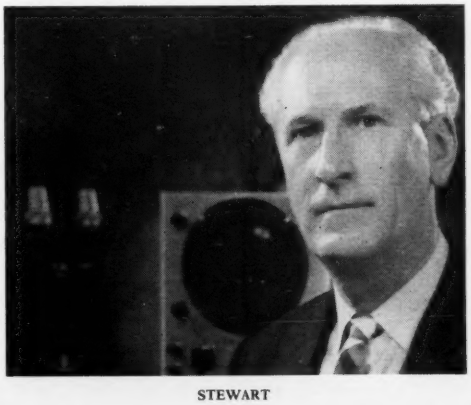
BALL

G. R. Ball, B.A.Sc., P.Eng., (Silicone rubber can do more than ever) got his degree in mechanical engineering at the University of Toronto in 1946. Joining the Union Carbide organization he worked on the development and application of silicones. Mr. Ball is a member of the APEO, the Chemical Institute of Canada and of the Niagara District Electric Club. He is one of Canada's leading amateurs with a golf club.



KARIAN

George Karian (Could powder metallurgy benefit you?) was born in Binghamton, New York, and graduated from Pennsylvania State University in 1949 with a B.S. in mechanical engineering. He then joined the F. J. Stokes Corporation and has been with the company ever since. Karian served 3½ years as a navigator in the 8th Air Force. His hobbies are bowling and golf and he lives in Palmyra.



STEWART

Scottish born R. C. Stewart (Blueprint for designing a thread tap) arrived in North Carolina at the age of two and in Canada when he was four. Educated in Ontario and B. C., he has more than 35 years experience in the manufacture of metal cutting tools and toolsteel metallurgy. He is chief metallurgist for the Vanadium Alloy Steel Co. at their London, Ontario, plant.

Problem

The B.C. Electric Company wanted a floor covering that would withstand heavy foot traffic . . . harmonize with interior colours and require a minimum of simple maintenance . . . for years to come.

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*Canadian General Tower Limited specified *Polysar Krylene NS for a custom-built, resilient "Peachglow" rubber tile because of its unsurpassed characteristics—initial light colour, colour stability, uniformity and ease of processing.*

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Reports

News in brief from the world's producers

New company

Canadian Steel Foundries (1956) Limited of Montreal and English Steel Corporation Limited of Sheffield, England, announce that they have formed a new company, **Canadian Steel Wheel Limited,** to manufacture wrought steel railway wheels in Montreal. This is the first time rolled steel railway wheels have been manufactured in Canada. The new plant will have a capacity of 200,000 wheels per year. Canadian Steel Foundries is a member of the A. V. Roe Canada Group, a subsidiary of the Hawker Siddeley Group of England and was formed to take over the steel foundry division of Canadian Car Co. Ltd., which is one of the largest suppliers of cast iron wheels to Canadian railways.

Locomotive milestone

The locomotive that rolled off the assembly line at **General Motors Diesel Ltd.,** in London, Ont., on Friday, April 5 was greeted with more than usual interest.

The streamlined passenger units for the CNR marked an impressive milestone for the big locomotive plant. It was the 1,000th unit built since the company began operations in 1950.

Award of merit

At each triennial reunion, the **Engineering Alumni Association** of the University of Toronto presents two medals to two outstanding graduates in engineering. The purpose of the award is to recognize the accomplishments of engineers (graduates in applied science of the University of Toronto) who, in an unobstrusive way, have contributed greatly to engineering knowledge or have been successful in developing methods or machinery for the advancement of Canadian industry.

The Engineering Alumni Association has appointed a committee which is seeking the co-operation of all graduates to find men worthy of the award. Nominations with complete pertinent information should be sent to J. Dudley Barnes, secretary, Engineering Alumni Medal Committee, c/o Canadian Standard Association, Box 506, Weston, Toronto 15. Nominations must be received before July 1.

New Montreal office

The Wallace Barnes Company Limited, Hamilton, Canadian subsidiary of Associated Spring Corporation, Bristol, Connecticut, has opened a new sales office in Montreal to give better service to the growing number of industrial plants in the Maritimes and the Province of Quebec.

The Wallace Barnes Company was established in 1921 by the Wallace Barnes Company of Bristol, Connecticut, which was merged with two other pioneer American Spring manufacturers in 1923 to form Associated Spring Corporation.

Climatic suite

The air conditioning and refrigeration division of **John Inglis Company** has been awarded a contract by Defence Construction (1951) Limited to design and construct a climatic suite for the Defense Research Medical Laboratory at Downsview, Ontario. The suite will enable the laboratory to study, under closely controlled circumstances, the effects on the human system of a very wide range of climatic conditions and is expected to provide an outstanding addition to Canadian research facilities.

The suite, to be built within the present concrete construction, will contain three separate heavily insulated climate rooms — a dry cold room, a wet cold room and a tropical room.

Language barrier

In the opinion of Ernest Zucker, application engineer with **Canadian Westinghouse Company Limited,** a great amount of useful technical information could be obtained from many foreign publications arriving in Canada were it not for the barrier of language. "Most people," says Mr. Zucker, "do not realize that it is within the reach of every engineer to obtain the gist of the information given without the aid of an experienced translater. Many technical terms are used internationally. Such words as telephone, telegraph, compressor and thousands of others can be found as part of practically every modern language."

In a fascinating article titled "Breaking the Language Barrier" Mr. Zucker explains the method behind his idea to make the engineer technically multilingual, offers suggestions for study and practice and gives some examples for his readers to try. (200)

Canadair venture

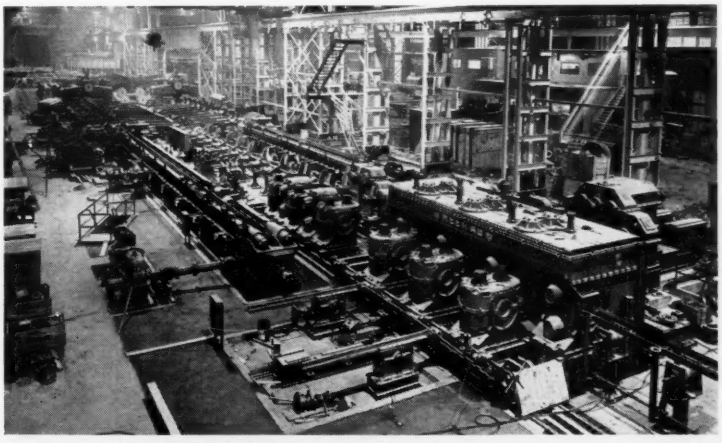
Canadair Limited, whose facilities have been fully occupied by military production for the past five years, has re-entered the international commercial aviation field by virtue of an agreement with the Bristol Aeroplane Company of England.

By this agreement, the Montreal Aircraft Company has acquired extensive rights in specific areas for the production and sale of a Canadair derivative of the Bristol Britannia. It will be known as the CL-44 and will have airliner, freighter and military transport configurations all powered by the new Bristol Orion engine.

Seamless tubing mill

The world's first completely automatic plant manufacturing seamless steel tubing will mark a new era in the industry when the **Mannesmann Tube Co. Ltd.,** inaugurates their plant in June at Sault Ste. Marie.

The highly mechanized mill, which is housed in a windowless steel building over a quarter mile long and 200 ft. wide, was built at a cost of approximately $20 million. The plant will be a truly "pushbutton" operation from steel rounds to the completed tubes. Despite extensive automation, an estimated 500 workers will be required to operate



View toward the furnace of Mannesmann's plant. (See "Seamless tubing mill")

Dr. Gerhard Wagner, president Mannesmann Tube Co. and Maj. Gen. Kenneth Buchanan, US (Ret.) inspect heavy equipment at Mannesmann's new tube plant.

the mill when it is in production. Aside from a few key men from Germany, all employees will be hired and trained locally. The labor force of 500 men is geared to produce approximately 225,000 tons of finished seamless steel tubes annually, which works out to about 450 tons per man year.

Digital computer

By the addition of a Bendix G-15D digital computer to the data processing centre of **Computer Devices of Canada** this Ottawa company claims the most complete and diversified computing and data processing facilities in Canada.

In a typical example using a G-15D computer, 17 hours were used to solve a problem that would have taken 2,916 hours by manual method. The problem involved computation of the specific nozzle area, output, and fuel consumption of a gas turbine, based on turbine design data and free stream conditions.

Giant generators

Five hydro electric generators of world record capacity will be built for the Aluminum Company of Canada by **Canadian General Elecric** plant in Peterborough, Ontario.

Each of the generators is rated at 165,000 kva. This will make them the largest known units in terms of power output.

The five generators are for installation on the Peribonka River in northern Quebec where Alcan is building a million-horsepower hydro development to serve the company's huge plant at Arvida.

Next month in Design Engineering

JULY

A questionnaire sent to our readers recently asked: "Would you find an annual handbook of value to you?" Almost 100% said they would and specifically asked that it contain news on product design applied to components and materials and information on new products.

Design Engineering has made plans to meet this demand in July with its **Component Application Guide**—a compact report on new products and their design application techniques.

The Guide will be separated into divisions such as fasteners, testing equipment, machine tools and so forth. An easy-to-operate indexing system will make the Guide an invaluable reference source for the design engineer with a component application problem.

All this then, in July. Be on the lookout for the issue and, if you can, hold on to it when it arrives.

Trends

Watchdogs

The difficult job of studying the cycles and efficiency of automatic machinery is being solved by the introduction of automatic machine efficiency "watchdogs." These take the form of cycle recording and cycle control devices which supersede the now inadequate "eyeball" and "stopwatch" methods of timing automated machinery. One such device (The Sheffield Corporation's Monitorecord Instrument) is now being widely applied to time and control automatic machinery performance beyond the capabilities of human observation.

Plastic tooling

The most extensive and complete bibliography yet compiled on the subject of plastic tooling has been made available by the American Society of Tool Engineers research fund, it was announced recently. It was compiled by Orville D. Lascoe (Professor of Industrial Engineering at Purdue University) as part of the plastic tooling research project currently being conducted under the auspices of the ASTE research fund.

One piece sleeve

A tubular compression joint suitable for communication and distribution line work has been developed by the Aluminum Co. of Canada Ltd. It is called the Unijoint, since it consists of a single sleeve only. Compared with former joining methods, the Unijoint is lower in first cost and since installation is greatly simplified, line erection costs are also considerably reduced.

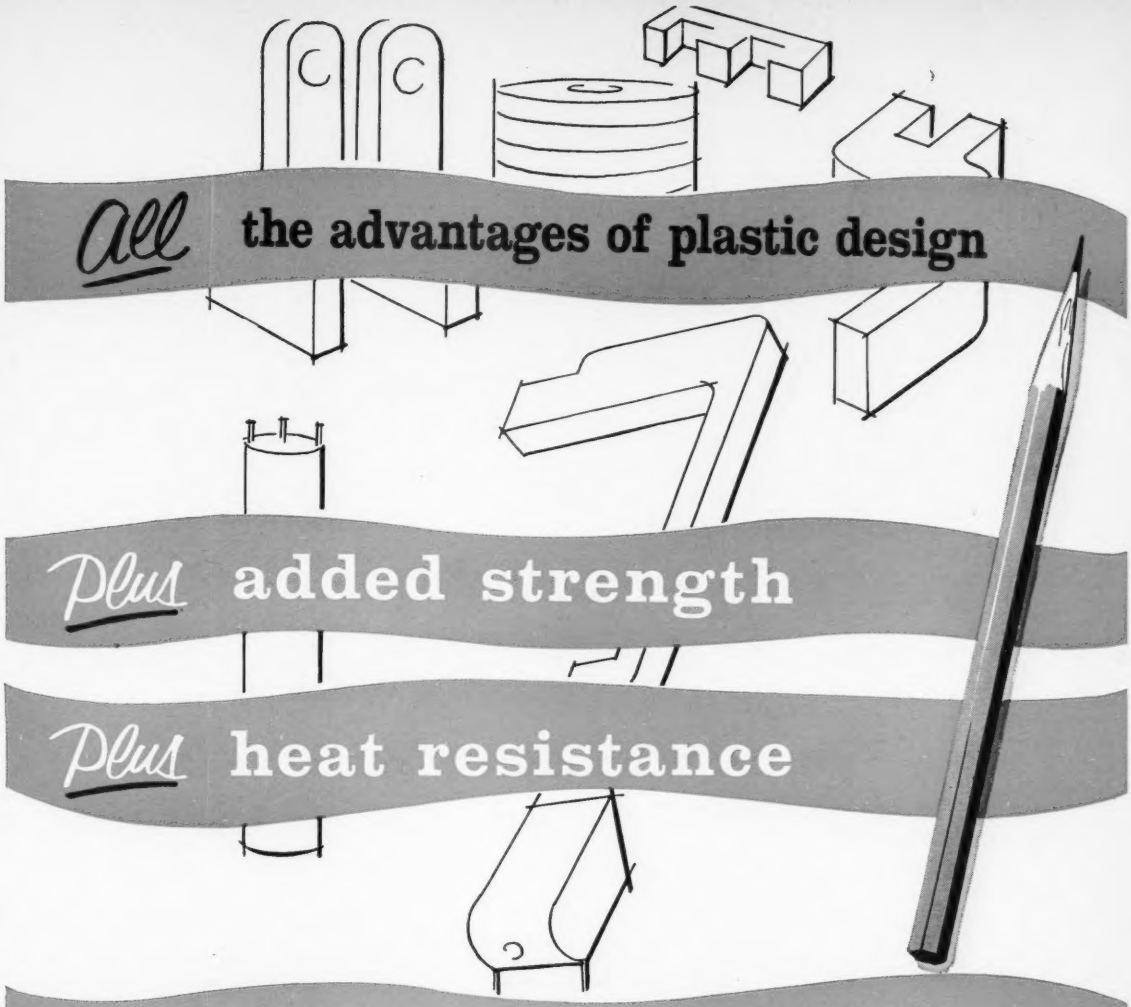
ASTE papers

Presented at the 25th Anniversary meeting in Houston, Texas: Fundamentals and application of thread and form rolling (Clifford T. Appleton); Power roll forming (J. W. Bergman); Oxide cutting tools (Robert F. Rea); Ceramic tool geometry and preparation (H. D. Moore and D. R. Kibbey); The history of plastic tooling (Appy Juras).

Transistors

Three high frequency transistors that are expected to extend the applications for transistors into equipment now limited to vacuum tubes are announced by C.G.E. Included among some of the possible applications are tv sets, radar and two-way radio transmitters and receivers.

The three transistors are germanium tetrodes; that is, they have four leads for connecting to an electronic circuit.



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*T.M. Reg'd.

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Background: Unretouched photomicrograph of grain structure of 4140 alloy steel, normalized and tempered, produced and spun at Acipco. Magnification 200X.

A Better Pattern For Your Designs...

ACIPCO

Centrifugally Spun STEEL TUBES

This photomicrograph of the grain structure of the Acipco steel tube shows why parts made from these quality tubes are both easier to make and more economical to use.

Because it is centrifugally spun, the Acipco steel tube grain structure is more even, more dense, and more free from inclusions. This non-directional granular pattern means easier machining, greater strength, and greater durability in any design.

Non-directional grain structure is only one of the advantages you get when you specify and use Acipco Steel Tubes. If you manufacture or design products requiring tubular steel, write or call for full information about Acipco steel tube applications in your field.

SIZE RANGE: Lengths up to 16′ — longer lengths by welding tubes together. OD's from 2.25″ to 50″; wall thicknesses from .25″ to 4″.

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FURNISHED: As cast, rough machined, or finish machined, including honing.

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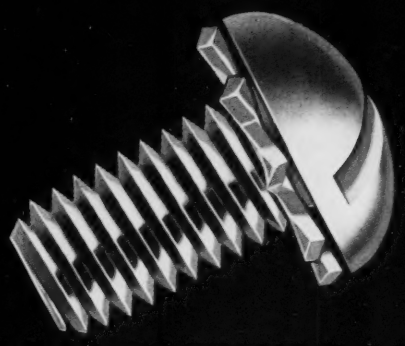

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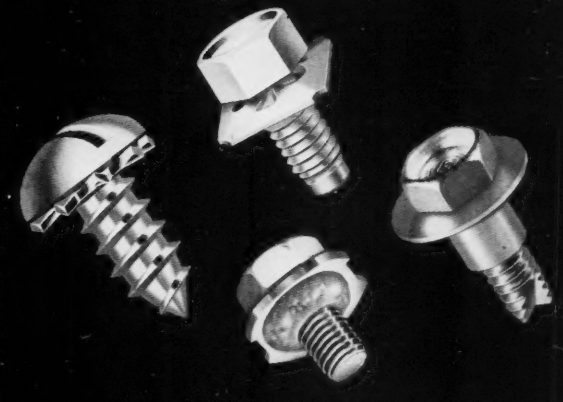
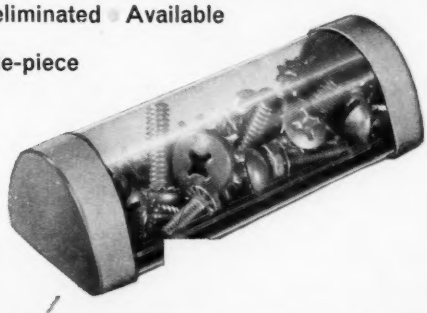


Even greater cost-savings are possible with Sems-by-Shakeproof through variations in threads, points, heads, and washers, or with the addition of sealing compound or special sleeves.

You handle one unit instead of two or more with Sems-by-Shakeproof • Every lock washer is factory-matched • Lost and forgotten washers eliminated • Available in variety of screw and lock washer combinations, multiple-piece assemblies and with mastic sealants.



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5706

Neoprene bellows encloses complex mechanism that controls pitch of blades and angle of rotor hub. The flexible housing must withstand hot oil on inside, sun and weather outside.

New rotor has 1200 fewer parts, more time to fly

Rotor maintenance time reduced 75% with help of neoprene—a Du Pont man-made rubber

Doman Helicopter, Inc., Danbury, Conn., has developed a simplified rotor design, featuring a rotating hub that tilts in any direction. It has 1200 fewer parts than conventional non-tilting rotors, and requires far less maintenance.

To make their tilting rotor practical, Doman had to find a flexible housing. The material to be used in the housing had to protect the mechanical assembly from dirt and rain, and resist sunlight and weather. It had to have outstanding resistance to the hot (225° F.) oil which bathes the moving parts. Doman's rubber goods supplier knew from experience that only neoprene had the combination of needed properties to meet these varied requirements. Tests confirmed the soundness of their recommendations.

Because of its balanced combination of properties, neoprene can help cut costs of replacing rubber products you use or improve performance of products you make. The technical representative of your rubber goods supplier can show you the benefits of neoprene and Du Pont's *new* man-made rubber, HYPALON*. To get the full story about both elastomers in a free booklet, just mail the coupon below.

*E. I. du Pont Trade Mark.

DU PONT CANADA

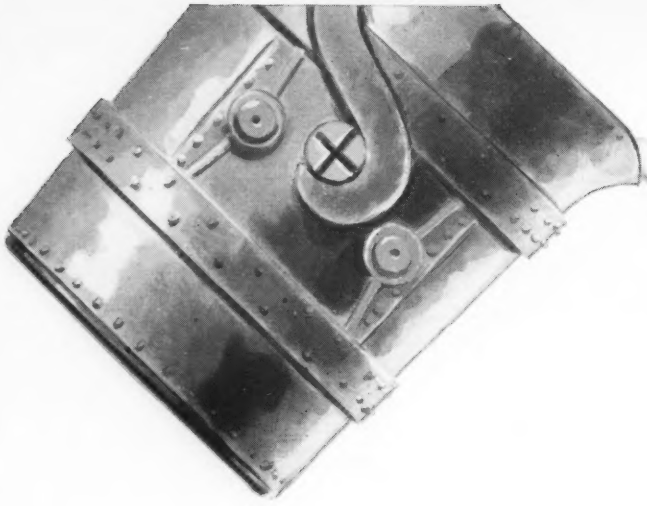
NEOPRENE
—made by Du Pont for 25 years

Du Pont Company of Canada (1956) Limited,
Chemicals Dept., Room A-4,
P.O. Box 660, Montreal, Que.

Please send me a copy of your free booklet, "The Du Pont Elastomers .. a Management Report."

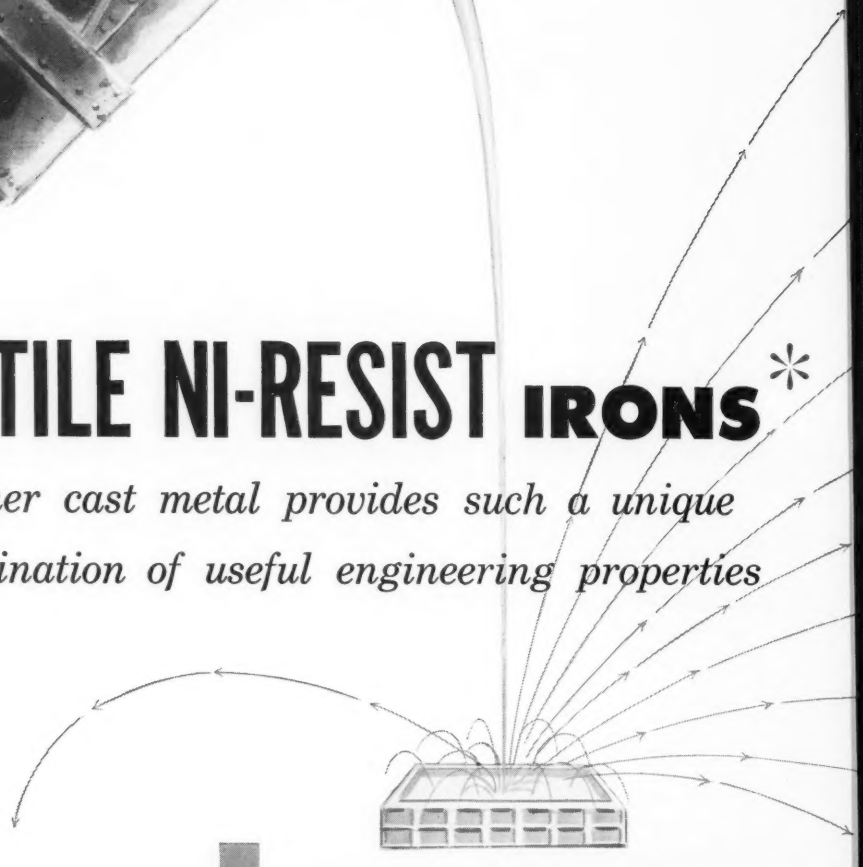
Name_____
Position_____
Firm_____
Address_____
City, Prov._____

MAIL THIS COUPON NOW—WHILE YOU'RE THINKING ABOUT IT



DUCTILE NI-RESIST IRONS*

no other cast metal provides such a unique combination of useful engineering properties



ENTIRELY CI CANADIAN

Canada Iron
foundries limited
FOUNDRY AND MACHINE DIVISION

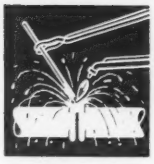
HEAD OFFICE: 921 SUN LIFE BUILDING, MONTREAL
TORONTO OFFICE: 169 EASTERN AVE., TORONTO

* For detailed information write for a copy of "Ductile Ni-Resist". You are not obligated in any way.

DN-1

Corrosion Resistance:

Acid, alkali, and salt handling problems have been solved by Ductile Ni-Resist.



Weldability:

No difficulty in welding in shop or field.

Toughness:

Impact resistance of Ductile Ni-Resist is comparable to that of steel at ordinary temperatures; an important plus is that it suffers no appreciable embrittlement at sub-zero temperatures.

Erosion Resistance:

The Ductile Ni-Resist series of irons show economical service under many erosive conditions; and resistance to erosion as in a pump impeller is outstanding.

Ductility:

Ductile Ni-Resist irons possess 10 to 40% elongation in a tensile test, ample for all normal service applications.

Castability:

Good flowing quality of Ductile Ni-Resist permits the casting of intricate designs, which are difficult to produce in some other cast corrosion-resistant metals.

Machinability:

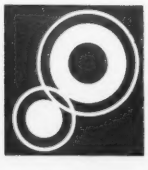
Machinability rates of Ductile Ni-Resist are of the same order as those of conventional pressure type gray iron.

Heat Resistance:

A high order of heat resistance is available with Ductile Ni-Resist up to 1300 deg. F. Certain types are recommended for service up to 1500 deg. F. Ductile Ni-Resist irons not only reduce the rate of oxidization, but also the oxidization products adhere tenaciously to the base metal.

Controlled Expansion:

Expansivities from 4.5 to 10.4 millionths per deg. F. are available with the different types of Ductile Ni-Resist.



Wear Resistance:

Metal to metal rubbing parts last much longer and perform better, especially under corrosive conditions, when made of Ductile Ni-Resist.

Non-Magnetic:

Some types of Ductile Ni-Resist irons are non-magnetic, and are therefore useful in many applications in the electric and allied fields where this quality, and the many others that this alloy has to offer, are required.

Applying paint or soothing pain
"BAKELITE" Polyethylene
plays an important part

Paint rolls on faster, s-m-o-o-t-h-e-r, with this award-winning **Flo-matic** paint roller mounted on polyethylene. The roller—chosen by the National Industrial Design Council for outstanding design—runs effortlessly on two polyethylene end bearings, which snap off and on for easy sleeve replacement.

Polyethylene is a natural for this job, just as it is for guarding **CURAD** plastic bandages until they're ready for use. The polyethylene film peels off, leaving the gauze pad and adhesive sanitary-clean.

. . . Just two of a hundred-and-one ways in which "Bakelite" polyethylene is making household chores easier and safer. Colorful, flexible polyethylene is today's most versatile plastic. Enquire about its many applications.

Flo-matic paint roller is produced by Rubberset Co. (Canada) Ltd., Gravenhurst, Ont.

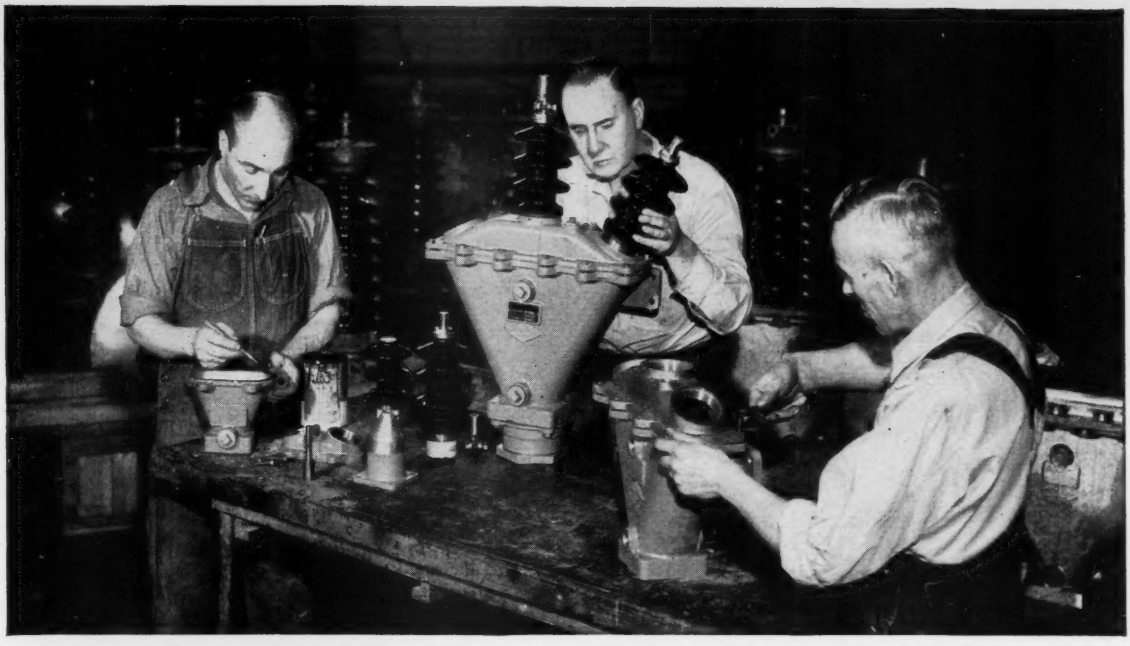
CURAD plastic bandages are produced by Bauer & Black, Toronto, Ont.
CURAD is a registered trade mark of The Kendall Company (Canada) Limited.

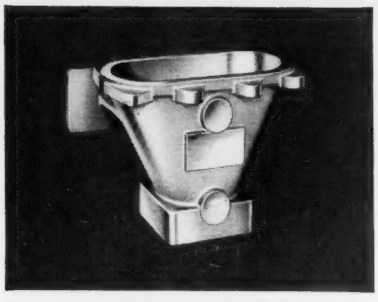
PHENOLICS • POLYSTYRENE • EPOXIES • POLYESTERS

BAKELITE
BRAND
POLYETHYLENE

"Bakelite" and the Trefoil device are registered trade marks.

BAKELITE COMPANY
A chief supplier of Plastic Raw Materials to Industry
Division of UCC Union Carbide Canada Limited
TORONTO • BELLEVILLE • MONTREAL





Canada Wire and Cable Potheads are sand cast from aluminum. These parts are subject to 25 p.s.i. pressure test.

How **C.S.I.** *"Clean Casting" Methods Save Production Time and Money for Canada Wire and Cable Co. Ltd.*

One of the most difficult jobs in aluminum casting is the production of pothead castings for terminating power cable. These castings are thin wall vessels of uniform thickness. They must be absolutely free from porosity since each casting must withstand a gas pressure test of 25 p.s.i.

Canada Wire ran into trouble in casting their aluminum potheads. The trouble was porosity. Too many of their potheads were coming from the casting moulds with pitted surfaces and porous structures—making them unfit for use.

Canada Wire took their problem to Canadian Steel Improvement Limited. Result: CSI "clean casting" methods are producing smooth-surfaced, structurally sound potheads that are able to withstand gas pressure testing. Each pothead is almost a finished product when it comes from the CSI casting moulds. In this way, Canadian Steel Improvement "clean casting" methods save Canada Wire production time and money—by producing trouble free castings.

If You have a Casting Problem, Call CSI

CSI "clean casting" methods apply to Sand, Permanent Mould and Pressure Die Castings in Aluminum and Magnesium.

CSI

CANADIAN STEEL IMPROVEMENT LIMITED

289 HORNER AVENUE, TORONTO 14, ONTARIO

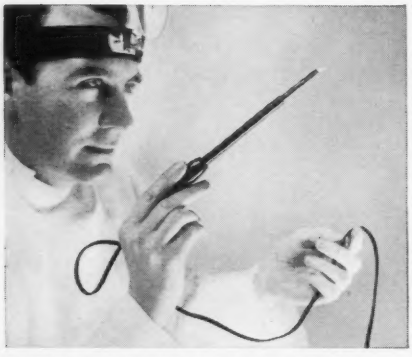
Represented in the United States ONLY by: C. F. RUSSELL COMPANY, INC., Bay Shore, New York

Forgings in Steel, Aluminum, High Temperature Alloys, Titanium.
Castings in Aluminum and Magnesium.

5518-R

CYANAMID

PLASTICS NEWSFRONT

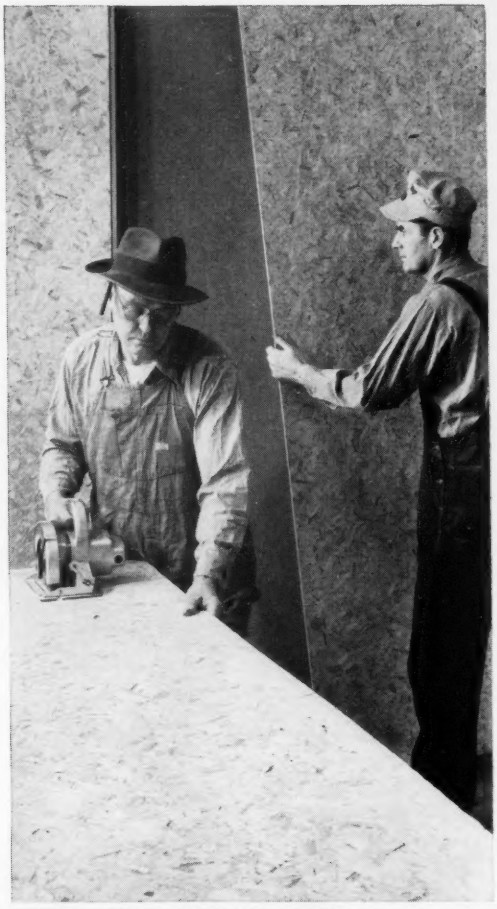


CYMEL* IN ELECTROSURGERY

High-frequency current flows between two sharp electrode tips in the 789 Bi-Active Coagulation Set used by physicians for removal of cervical cysts, tonsils and surface growths. The Birtcher Corp. of Los Angeles encases the electrodes in mineral-filled CYMEL Melamine Molding Compound because of its excellent insulating properties and smooth flow into the mold which simplifies accurate spacing of the tips. Handles and cord tips are molded of alpha-cellulose-filled CYMEL, also an excellent insulator. All surfaces are exceptionally hard, chip resistant and can be sterilized easily. *Trademark

MODERN TOUCH IN WIRING DEVICES

Home styling today favors light, cheerful colors. This note is carried out perfectly with wiring devices molded of ivory-colored BEETLE® Urea Molding Compound. Its hard, smooth surface resists discoloration and scratching, and safe dependable service is insured by BEETLE's excellent insulating properties.



WOOD CHIPS BUILD A WALL

These attractive panels are made of wood particles bonded with MELURAC® Melamine-urea Resin. This low-cost particle board has good warp resistance, flexural strength, moisture resistance and easy working and finishing properties. In addition to structural uses—walls, sliding doors, partitions, ceilings, subflooring, parquet flooring—it is ideal for furniture core and underlayment of decorative melamine laminates. MELURAC 304, developed expressly for this use, imparts no color and improves strength of the particle board.

50 CYANAMID 1907 1957

NORTH AMERICAN CYANAMID LIMITED
PLASTICS AND RESINS DIVISION
160 BLOOR STREET EAST, TORONTO 5, ONTARIO

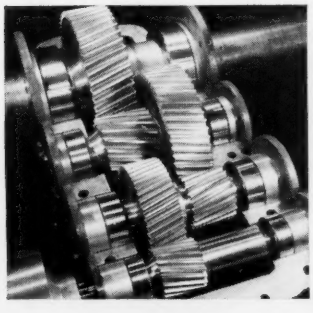
CYANAMID Plastics and Resins Division
MATERIALS FOR TOMORROW

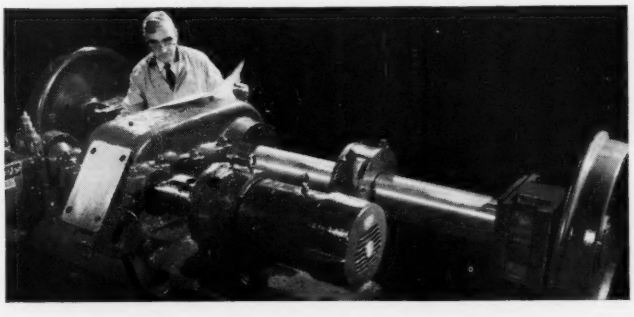
Special Self-Propelled Drive Mechanism Illustrates Engineering Skill of Hamilton Gear

When Dominion Foundries and Steel, Limited required a new type of drive mechanism for a number of self-propelled ingot mould transfer cars, they called in Hamilton Gear. The challenging problem: to move a 300 ton gross weight at a track speed of less than one mile an hour using as a source of power a 10 H.P. standard speed electric motor. The total gear ratio between the motor and the car axle is 186 to 1.

Hamilton Gear designed and built the compact assembly shown below, which incorporates an axle of the transfer car and constitutes a completely self-contained drive mechanism. It combines a standard Hamilton Gear motorized speed reducer with a specially engineered helical gear reduction box, interior of which is shown on the lower left.

For this type of unusual and complex custom design work, or for the simplest gear application in any industry, consult with Hamilton Gear. They will gladly work with you on your gear and speed reducer problems.





Hamilton Gear and Machine Co., Limited.

950•990 DUPONT ST., TORONTO 4

MONTREAL office—6785 Upper Lachine Road
WINNIPEG office—The Cuthbert Company Ltd., 19 MacPhillips St.
EDMONTON office—John H. Ross and Co. Ltd., 6803 - 104th St.
VANCOUVER office—B.C. Conveying Machinery Ltd., 3300 Fraser St.

G-1-57

You get many "plus" benefits at C.S.F.

And rightly so, for magnitude of operation, the most modern equipment and the knowledge and skill of 1,500 highly trained personnel make "plus" benefits a part of every job we undertake.

Additional advantages, too, follow the calling in of C.S.F. Sales Engineers in the initial stage of product development. Remember, the best Castings start at the drawing board!

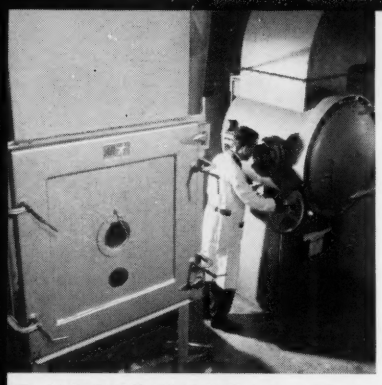
CANADIAN STEEL FOUNDRIES (1956) LIMITED

5227 NOTRE DAME E., MONTREAL 4.

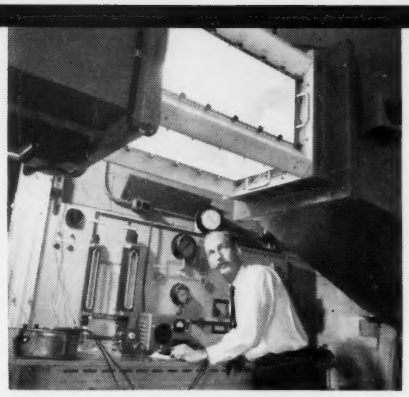
Members: A. V. Roe Canada Limited and The Hawker Siddeley Group

SALT SPRAY AND HUMIDITY CHAMBER H
a working space 48x36x26 in The Engineeri
staff of ARL is available to laboratory custome

HORIZONTAL MECHANICAL VIBRATOR, used here by Dr. Everett Braaten, test lab chief, has a capacity of 1,000 g lbs., a maximum load of 150 lbs. and a maximum displacement of .125 inches in the horizontal plane within the frequency range of 10 to 60 cycles/sec. A vertical mechanical vibrator of the same performance range is also available.



ND AND DUST CHAMBER, left, and Explo- chamber, right, have working spaces of 3x3x3 , and 3-ft. diameter x 4-ft. length, respectively.

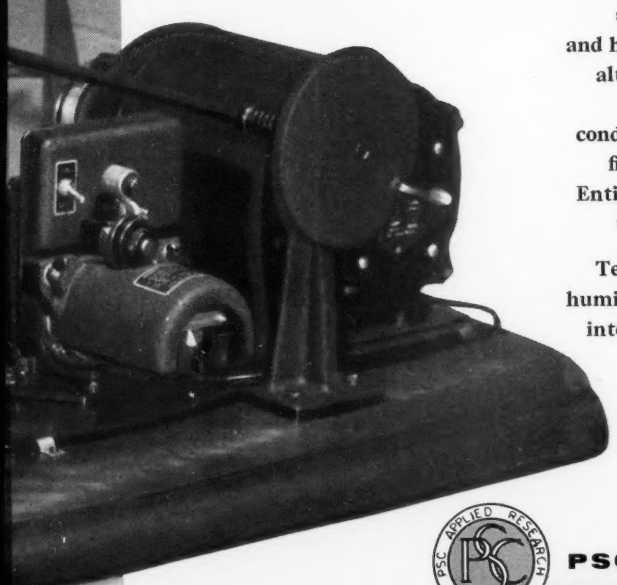


ICING WIND TUNNEL, with present 24 h.p. motors, has a maximum indicated airspeed in excess of 400 f.p.s. Work space cross section is 12x12 in.

TEMPERATURE ALTITUDE CHAMBER has a 27 cu. ft. capacity. Tests from −100°F. to 300°F., at altitudes from sea level to 100,000 ft.

TAILORED FOR TORTURE

Equipment takes its worst punishment at new PSC Applied Research test lab



"FOR their own highly specialized purposes, engineers and researchers can now, practically speaking, fly around the world without leaving 3,000 square feet of floor space at PSC Applied Research Ltd.'s environmental test lab in Toronto. Moisture congealing Arctic temperatures; buffeting, shock and strain of severe air turbulence; corroding heat and humidity in the tropics; icing and air pressure at high altitudes—these are the facts of world flight most interesting to design engineers. They are among conditions now duplicated in detail at ARL's new lab—the first private enterprise establishment of its kind in Canada. Entire facilities of the laboratory are being offered to industry and government on a commercial basis."*

Tests available: low and high temperature, altitude, humidity, shock, vibration, salt spray, sand and dust, radio interference, explosion, fungus, wind tunnel.

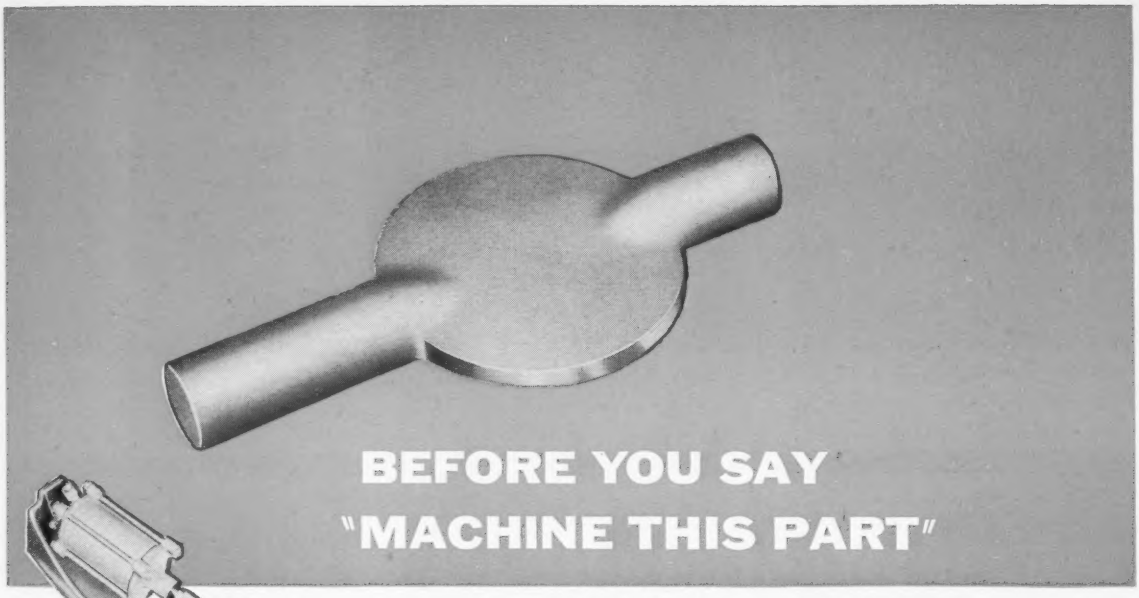
Literature is available on request, giving full details of each test facility.

**Canadian Aviation magazine,*

PSC APPLIED RESEARCH LTD.

1500 O'CONNOR DRIVE
TORONTO 16, ONTARIO, CANADA
PLYMOUTH 5-3371

Member: A. V. Roe Canada Limited & Hawker Siddeley Group



BEFORE YOU SAY "MACHINE THIS PART"

Call an ESCO Casting Engineer

It's often the seemingly simple parts that cause the production "headaches". In this case the "butterfly"—the simple disk and shaft assembly in an exhaust gas actuated power brake. These small parts presented complicated machining and fabricating operations. The elliptical shape of the disk, the compound bevel of the disk edges, the slotting of short length of shafting, welding the shafting in perfect center and alignment on the disk and finally the turning of the shaft ends or bearings. All this fabrication had to be done in a heat-resistant steel to eliminate warpage of the disk, because the blow-by of exhaust gases would result in decreased operational efficiency of the power brake unit.

Oftentimes the answer to such a problem can be as simple as this one was.

. . . "Shellcast this part". And the result . . . a one piece casting combining the elliptical beveled disk with an integral shaft. Cast so smooth and to such close tolerances that the only machining operation to be performed was the bearing ends of the shaft. Heat-resistant *ESCO* Alloy 43H, (A297-55 Grade HH) also eliminated the warpage problem at the same time.

Whether you make butterfly valves, or any one of a million or more complicated components of either low or high alloy steels, before you say "machine this part" call an *ESCO* Casting Engineer.

Write for *ESCO* booklets No. 175 and No. 205.

ESCO LIMITED

8425 ONTARIO STREET, VANCOUVER, B.C.
2203 BEACONSFIELD AVE., MONTREAL, QUE.
32 TABER RD., TORONTO, ONT.

Designed for smooth, efficient operation in Eaton's 25-acre Service Building...

JENKINS VALVES

Two years of exhaustive research went into the planning of Eaton's vast new Service Building in Toronto. Almost a mile in circumference, it incorporates the most efficient time-saving methods and machines of the day to speed merchandise to Eaton's stores in the city. To handle "traffic" control for the building's heating arteries, Eaton's chose dependable Jenkins valves for maximum efficiency and minimum maintenance. Expert in retailing, Eaton's finds *it pays to deal with specialists.*

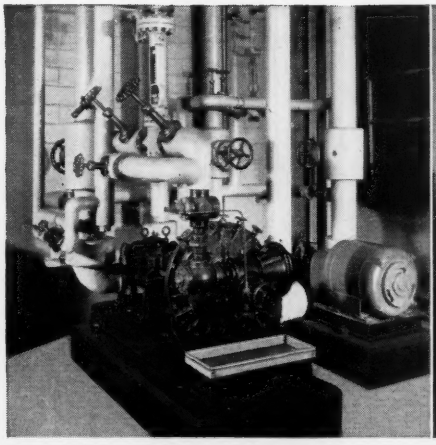
The Jenkins "Diamond" trade mark is your assurance of complete satisfaction.

JENKINS VALVES
LOOK FOR THE DIAMOND MARK
TRADE JENKINS MARK
Jenkins Bros

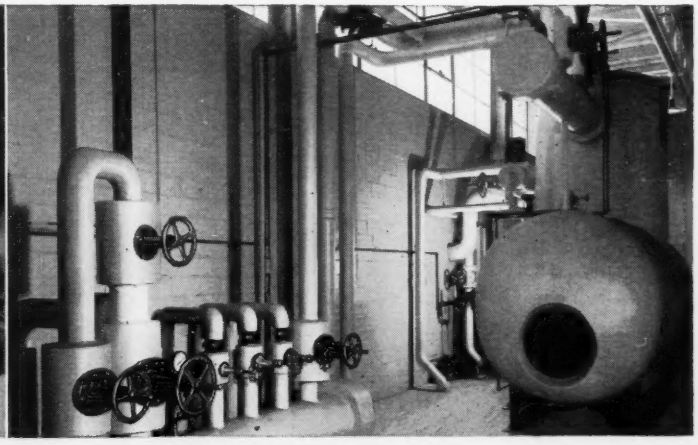
Making Quality Valves Is Our Business — Our Only Business

Sold through leading industrial distributors.

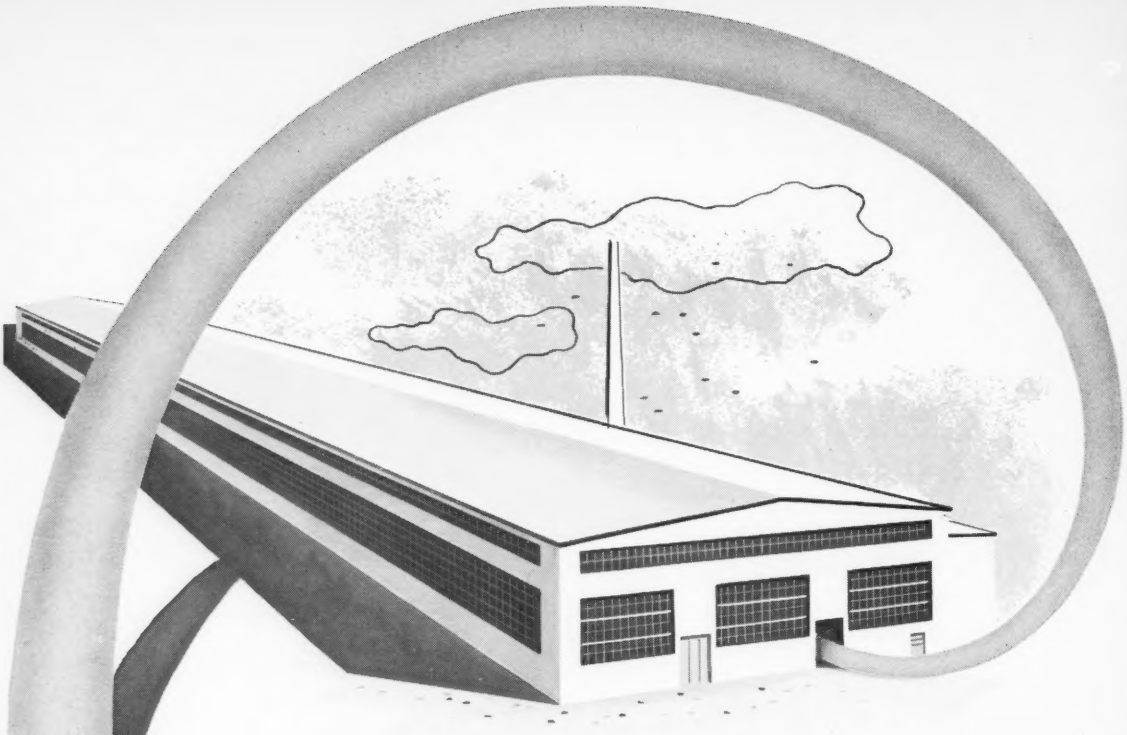
JENKINS BROS. LIMITED
Lachine, Montreal 32, Quebec
Sales Offices:
TORONTO, WINNIPEG, EDMONTON, VANCOUVER.



Jenkins Bronze globe, gate check, and Iron Body gate valves on the dual steam and electrically-driven boiler feed pump installation. Each pump can supply feed water at 175 lbs. pressure with a total output of 150 U.S. gallons per minute.



Partial view of the main distribution header and open feed water heater (de-aerating type), showing Jenkins Iron Body globe, gate and Bronze gate and check valves. The header is designed so that valves can be operated from the floor.



Now in production...

NORANDA'S NEW TUBE MILL

New Facilities Produce Superior Quality,
Increase Manufacturing Area 50%,
Climax Noranda's 10th Anniversary

Copper and copper alloy tubing manufactured in our new tube mill sets a new high standard for quality. The most modern equipment for production, inspection and test makes this possible.

Enthusiastic acceptance of our brass mill products at home and in world markets has necessitated the building of these new facilities. Now we can provide even more efficient service and higher NORANDA DIAMOND QUALITY in every product.

Users of copper, brass or bronze in sheet, strip, rod, wire or tube—or aluminum strip, can benefit by calling the nearest Noranda office for their requirements.

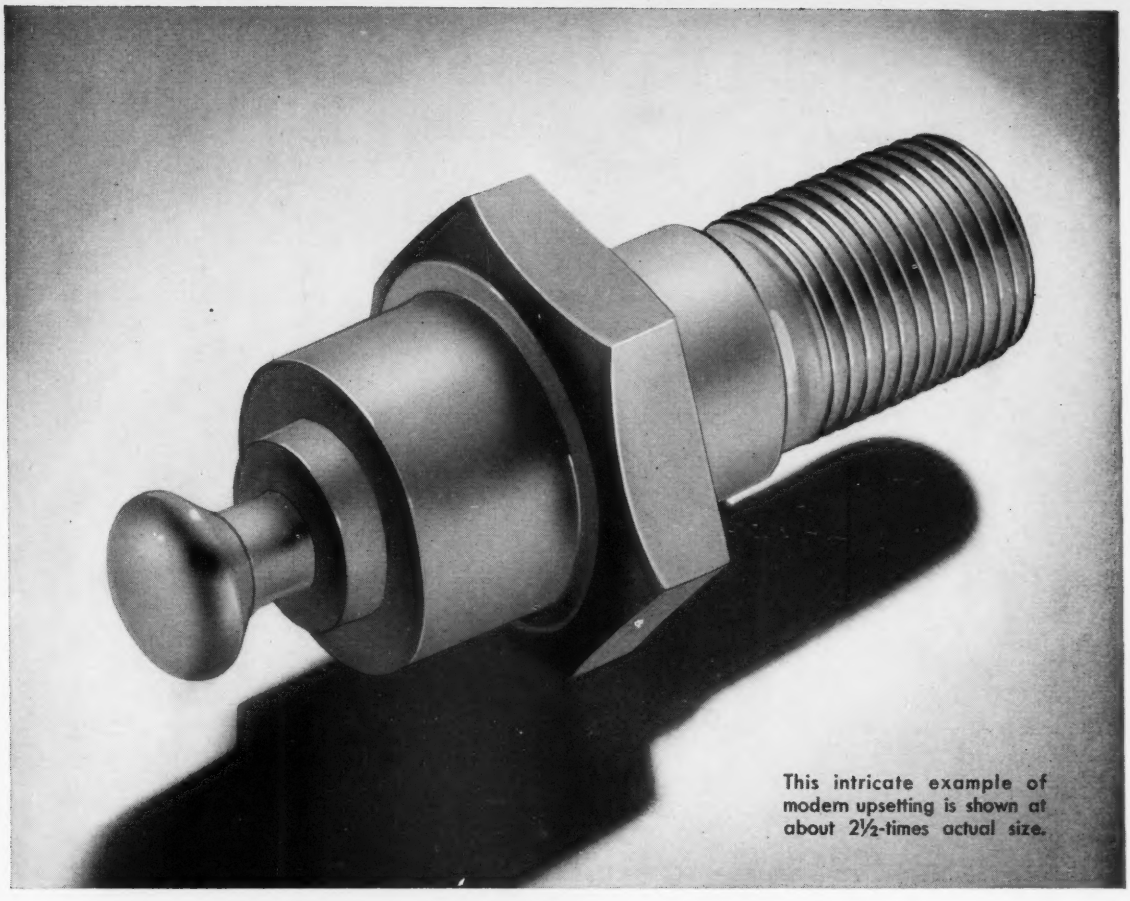
thank you

On this occasion, our 10th Anniversary, we take this opportunity to say "thank you" to our customers, suppliers and other business acquaintances. Your confidence, loyalty and cooperation have enabled us to grow and prosper and to make our contribution to the nation's progress.

You can be sure that the principles of quality and service, to which we have adhered in the past, will be the basis on which we will continue to serve old customers and new in the decades to come.

Noranda Copper and Brass Limited

Sales Offices: Montreal • Toronto • Edmonton • Vancouver



This intricate example of modern upsetting is shown at about 2½-times actual size.

How much would YOU save with a . . .

STELCO SPECIAL FASTENER ?

- *If you use a machined part . . .*
- *If you "make-do" with a standard fastener . . .*
- *If you use a forged fastener . . .*
- *If you have a fastener design problem . . .*

STELCO can probably save you money with a SPECIAL FASTENER

Where Special Fasteners are used the saving is not only in parts at a lower cost . . . but in faster, better assembly as well.

The Fastener shown above indicates the extremely wide design possibilities of Stelco Special Fasteners. The range of contoured and special shapes produced by Cold Heading is increased by threading, punching, shaving, and bending operations.

Cold Heading saves material and production time. Cold Headed parts are stronger and cheaper than similar machined pieces, cheaper than forgings and equally strong.

Stelco's Engineering Service can advise if a Special Fastener would be beneficial in *your* operation . . . if so, there is a substantial saving for *you*. Contact any Stelco Sales Office for further information.

THE STEEL COMPANY OF CANADA, LIMITED

Executive Offices: Hamilton — Montreal

Sales Offices: Halifax, Saint John, Montreal, Ottawa, Toronto, Hamilton, London, Windsor, Winnipeg, Edmonton, Vancouver.
J. C. Pratt & Co. Limited, St. John's, Newfoundland.

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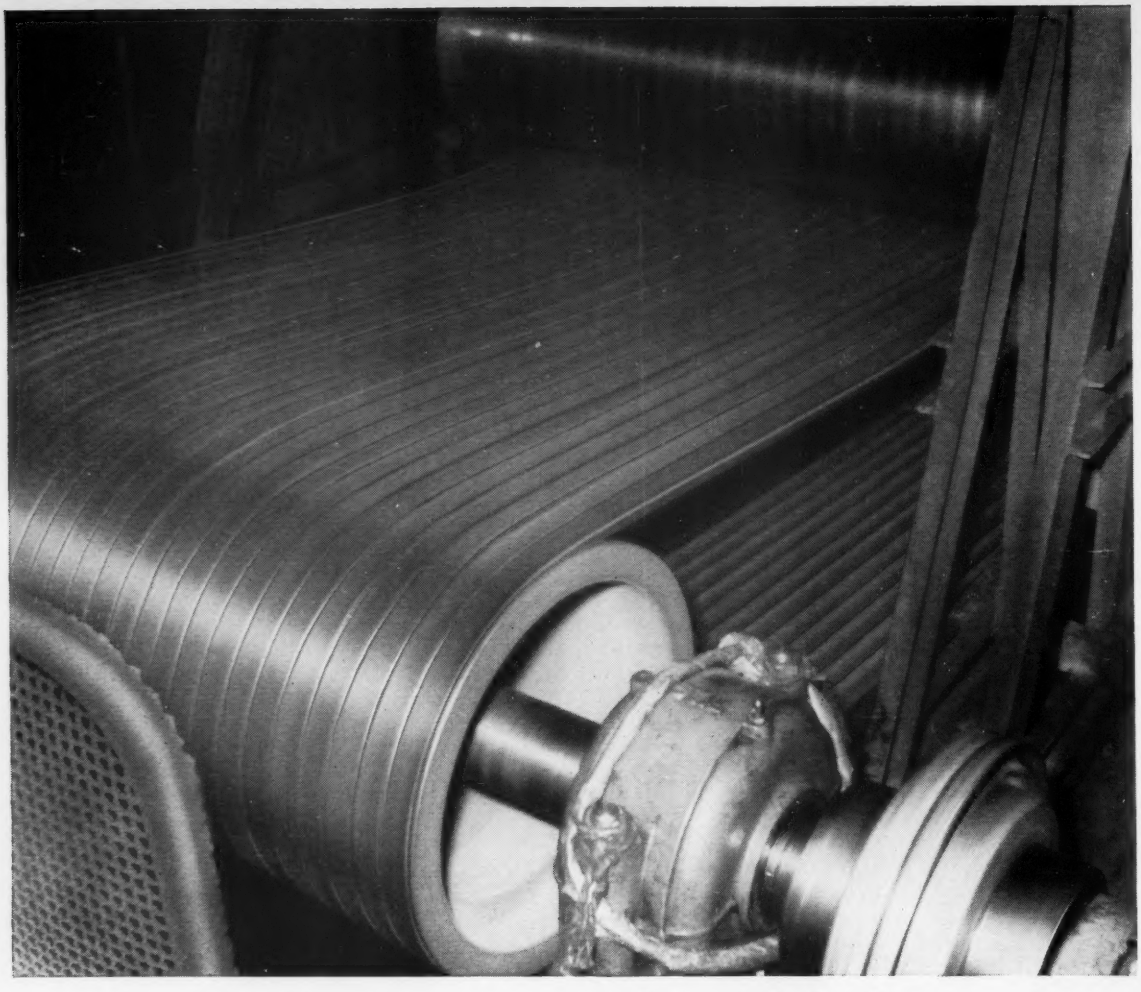


800 horsepower—*with a V-belt drive*

HERE'S an example of how power transmission equipment from United Steel puts horsepower to work for industry.

This V-belt drive at an Ontario paper mill has fixed centres and is equipped with a take-up idler. Thirty high capacity V-belts transmit power from an 800 h.p. motor to drive the lineshaft on one of the company's big paper-making machines.

Off-the-shelf-delivery—In addition to engineered drives like this, United Steel carries large stocks of standard power transmission equipment—some of which is illustrated below—to make off-the-shelf-delivery service possible. If you're going to pick it up, it's ready when your truck arrives—otherwise, it's on the way to you in quick time.

There's a United Steel warehouse located to serve you—just call: TORONTO, RO. 2-8242; MONTREAL, WE. 4277; KIRKLAND LAKE, 1017; SUDBURY, OS. 4-3053. *Dodge Manufacturing Division, United Steel Corporation Limited, 58 Pelham Avenue, Toronto 9.*

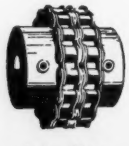
57-60

United Steel
CORPORATION LIMITED
TORONTO • MONTREAL • LONDON • GALT
WELLAND • KIRKLAND LAKE • SUDBURY

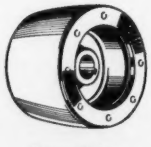
Taper Lock Sprockets

Torque Limiters

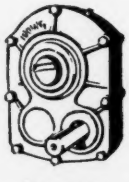
Roller and Silent Chain and Sprockets



Roller Chain Couplings



Paper Pulleys and Cast Iron Pulleys



Torque Arm Speed Reducers

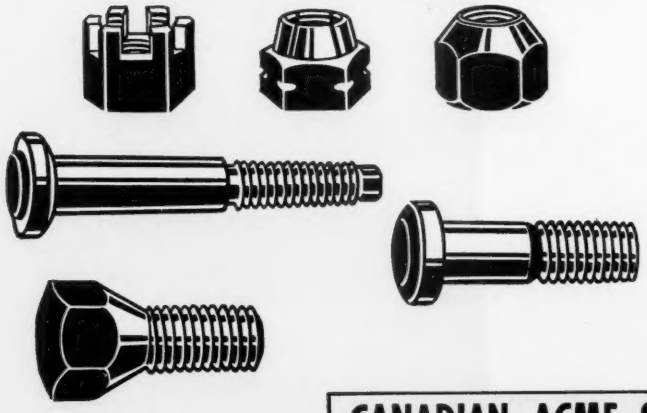
Cam Clutches

What's **SPECIAL** *about a* **SPECIAL**

Well, in the first place, it could be that you invented it. That would make it unique. The next step would be to have your special idea rendered in steel — or brass. That's where Acme comes in. Turning ideas into metal — no matter how special— is a job our engineers tackle with enthusiasm — and, of course, the right equipment.

Once our specialists have settled details and set up the Brown & Sharpe or Gridley Automatics, your idea becomes a fact — thousands of facts — rolling smoothly through acme's high speed production system, always under the watchful eyes of Acme engineers. These are the men upon whose pride in workmanship rests Acme's reputation for accuracy, quality and fast service.

There's something very special about Cold Heading and Cold Forming



Acme's aim is to achieve perfection. Our engineers are ever conscious of the necessity of producing customer's quality parts at the lowest possible cost. Endeavour to utilize this more economical method of fabricating steel.

CANADIAN ACME SCREW & GEAR, LIMITED

SPECIAL SCREW PRODUCTS DIVISION — 207 WESTON ROAD, TORONTO

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Western Agent
STANLEY BROCK LTD.
Winnipeg, Man. Edmonton, Alta.

Western Stocking Agent
STANLEY BROCK LTD.
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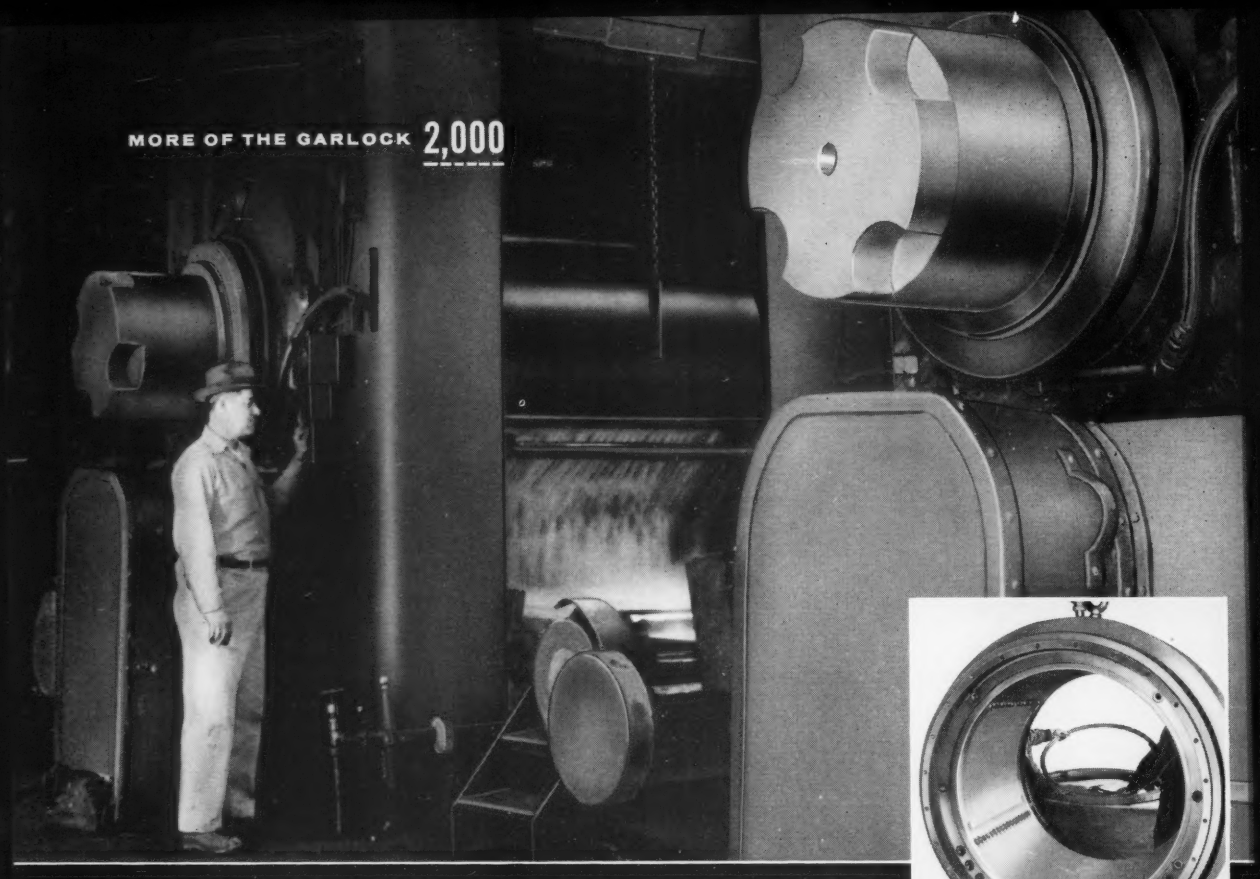
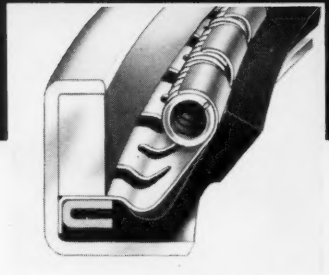


YOUNGSTOWN Equips Hot Strip Mills with Garlock KLOZURE* Oil Seals . . . SAVES OIL and MAINTENANCE TIME

Photo shows roll bearing in foreground with KLOZURE Oil Seal and retainer ring removed. In background a new KLOZURE Oil Seal is quickly inserted in retainer ring.



Cross section of Model 64 KLOZURE Oil Seals used on back-up rolls of steel mills.

Nine back-up rolls on the Hot Strip Mill illustrated have been equipped by Youngstown Sheet & Tube Company with 72 Garlock KLOZURE Oil Seals. The rolls run at speeds of 1025 ft. per min. Oil pressure is approximately 8 psi. at temperatures to 120° F.

Youngstown is able to roll a half a million tons of steel on this Mill before the KLOZURE Oil Seals need replacement. Furthermore, considerable maintenance time is saved when replacement seals are applied.

Also, a large percentage of oil has been saved due to the application of Garlock KLOZURE Oil Seals.

If you have an application that requires oil seals, why not investigate the advantages of KLOZURE Oil Seals. They are another important part of "the Garlock 2,000" . . . two thousand different styles of packings, gaskets, and seals for every need. It's the only complete line . . . that's why you get unbiased recommendations from your Garlock representative. Call him or write for KLOZURE Catalog.

THE GARLOCK PACKING COMPANY OF CANADA LTD.

• General Offices: Toronto, Ont.
Branch Offices: Hamilton, Montreal, Winnipeg, Edmonton, Vancouver

*Registered Trademark

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints

PRODUCT OF 3M RESEARCH

1500 formulations for industry

If you have two or more surfaces to join, there's a "3M" Adhesive that will do it faster, cheaper and more securely. If there's a surface to protect from mechanical damage, fumes, etc., during processing or shipping, there's a "3M" Coating or Sealer to do the job. Just state your needs.

Write and let us prescribe the formulation

3M COMPANY

ADHESIVES COATINGS SEALERS

MINNESOTA MINING & MANUFACTURING OF CANADA LIMITED
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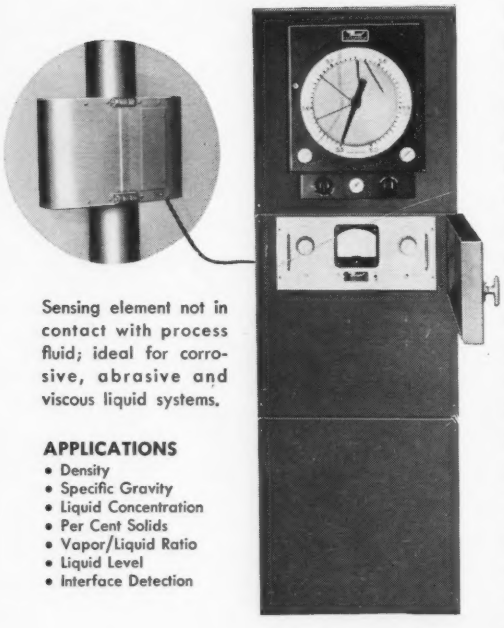
modernize and economize with these two new

Bendix COMPLEMENTARY CONTROLS

Continuous and Automatic

NUCLEAR DENSITY GAGE

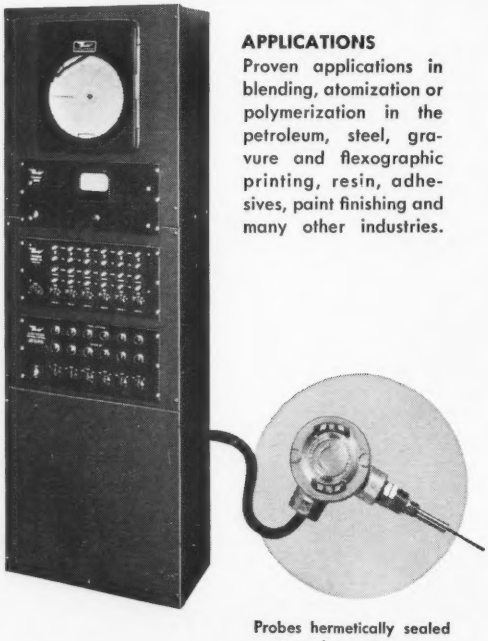


Sensing element not in contact with process fluid; ideal for corrosive, abrasive and viscous liquid systems.

APPLICATIONS

- Density
- Specific Gravity
- Liquid Concentration
- Per Cent Solids
- Vapor/Liquid Ratio
- Liquid Level
- Interface Detection

MULTIPOINT ULTRA-VISCOSON ELECTRONIC VISCOMETER



APPLICATIONS

Proven applications in blending, atomization or polymerization in the petroleum, steel, gravure and flexographic printing, resin, adhesives, paint finishing and many other industries.

Probes hermetically sealed —no moving parts.

CABINET SPECIFICATIONS

Standard rack panel mounting; dust-proof; air purgable (air purge kit available from Bendix).

Features:

The Bendix Nuclear Density Gage is designed for process pipelines. Range, Span and Time Constant adjustments on front panel. Meets every AEC requirement for industrial use. Range: 0.3 to 3.5 Sp. Gr. range with a minimum span of 0.05 Sp. Gr.

The Bendix Multipoint Ultra-Viscoson* electronic viscometer controls one to six individual stations. Automatic or manual selection of probe stations. Automatic or manual control of valves. Installation in pipelines, kettles, reactors. Ranges: 0—50,000 centipoises x grams/cc.

*REG. U.S. PAT. OFF.

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COMPUTING DEVICES OF CANADA LIMITED

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WESTERN DIVISION—Commercial Building, Edmonton, Alberta

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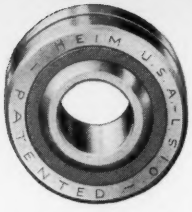
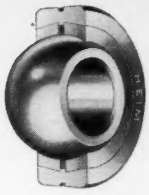
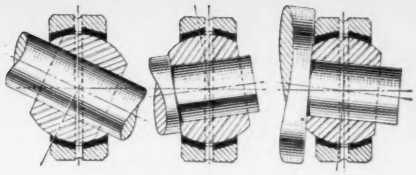


HEIM BEARING



Cutaway Shows Housing— Bronze Inserts— Hardened, Ground Ball



Maximum angle of misalignment

HEIM *Unibal* BEARINGS

Correct misalignment in every direction.

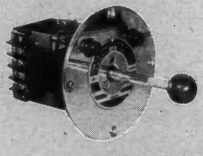
Carry heavier axial and thrust loads.

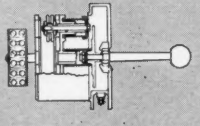
Reduce friction and lost motion.

Eliminate brinelling.

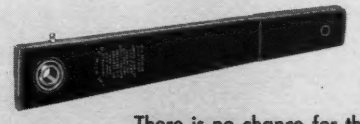
Economical to buy — easy to install.

A few examples of Unibal applications:

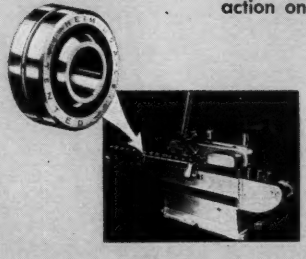




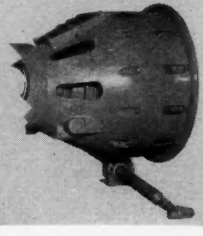
The pivot point for the operating lever which trips the motor switches controlling the searchlight is a Heim Unibal Bearing. This is a Carlisle & Finch electric searchlight controller.



There is no chance for the stud hole to enlarge in this sweepstick. The Heim Unibal Bearing assures smooth, trouble-free pick action on any loom.



This end of the Helicoid Timer on the Anchor Steriseal Machine is supported by a self-aligning Heim Unibal Bearing.



The transmission shifter rod on the giant Failing Oil Well Drilling Rig passes through this Heim Unibal to misalign with the changing position of the shaft.

The Heim catalog shows the complete range of sizes and load ratings. Please write for copy, or for specific engineering data.

R&M BEARINGS CANADA LTD.

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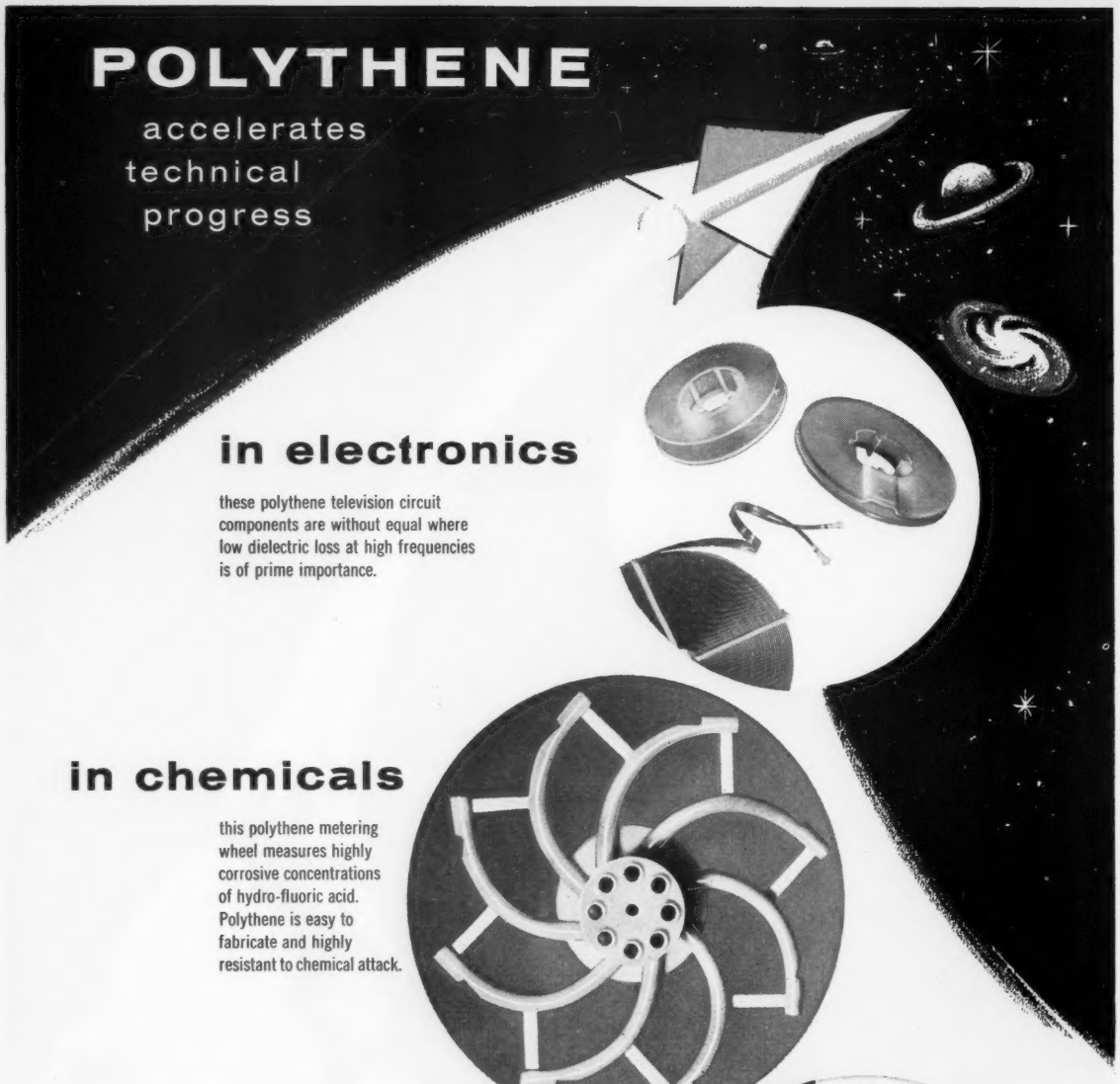
accelerates technical progress



in electronics

these polythene television circuit components are without equal where low dielectric loss at high frequencies is of prime importance.

in chemicals

this polythene metering wheel measures highly corrosive concentrations of hydro-fluoric acid. Polythene is easy to fabricate and highly resistant to chemical attack.

in air conditioning

air filters packed with shredded polythene develop a high electrostatic charge, collect dust and dirt, yet wash clean quickly and easily. These filters are used in the new air conditioning system of the Sheraton-Mount Royal Hotel.

Designers in all fields!

UTILIZE POLYTHENE'S SPECIAL PROPERTIES! it's light, tough, non-toxic, chemically inert; has exceptional dielectric characteristics, remains flexible and strong even at sub-zero temperatures.

for further information and technical service, write:

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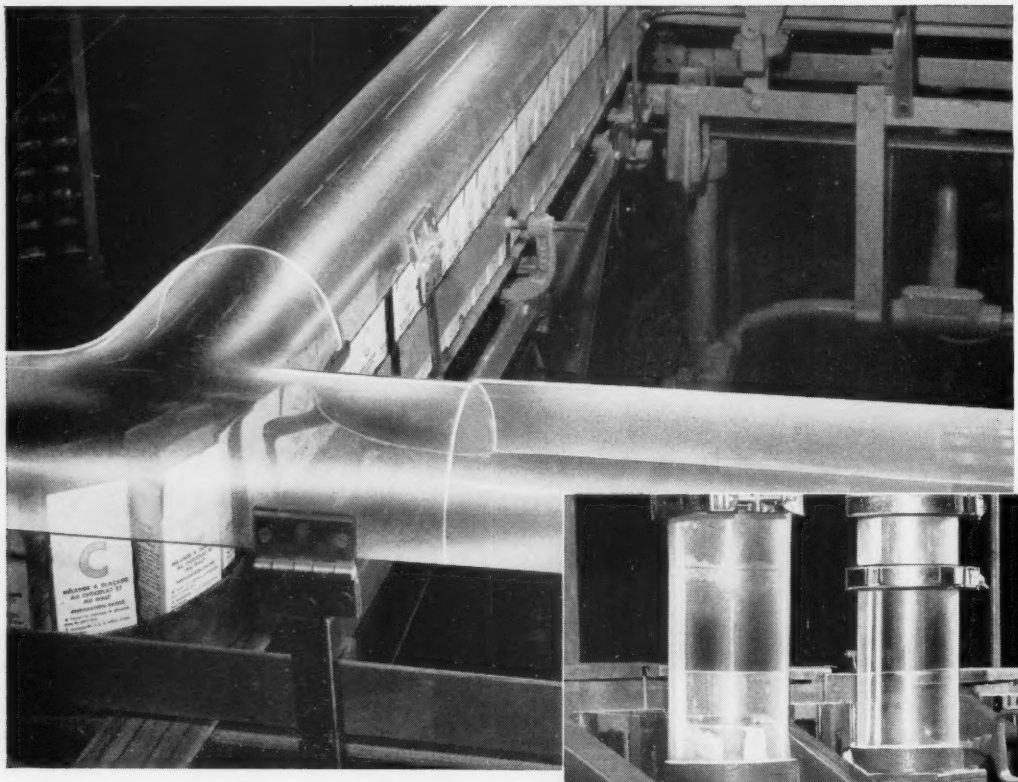
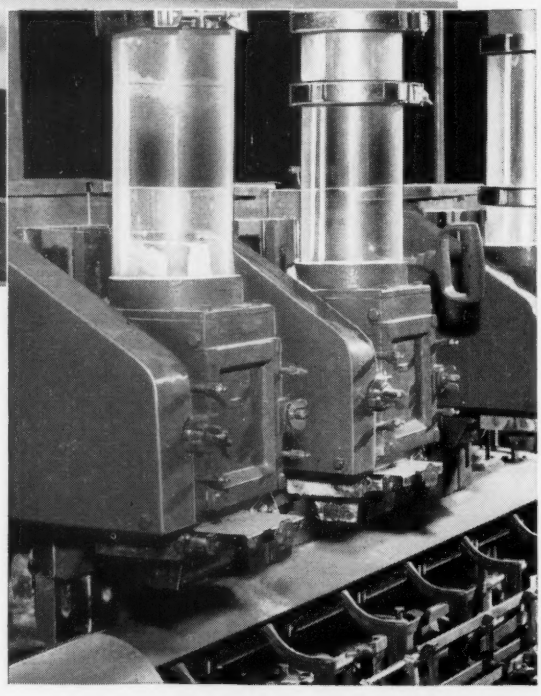
P.O. Box 10, Montreal,
suppliers of polythene
resin to convertors

C-I-L POLYTHENE

PLEXIGLAS*

at work in industry!





These photographs taken at the General Mills (Canada) Limited plant in suburban Toronto, show Plexiglas at work in industry.

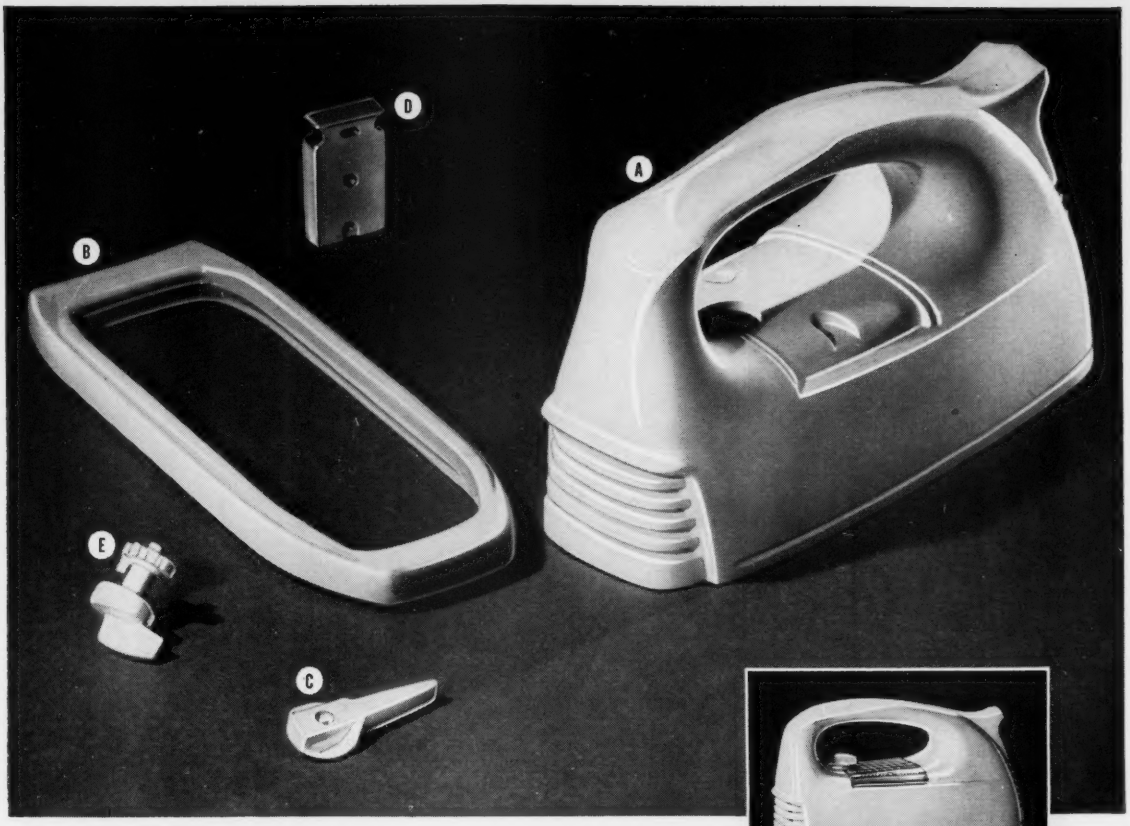
These covers on the cake-mix filling line allow the operators to constantly check the packages, while dust is kept confined to a small area. The Plexiglas down-pipes allow the operator to see that the cake-mix remains free-flowing at all times.

This is but one example of Plexiglas at work, designed by the engineers at General Mills (Canada) Limited.

CRYSTAL GLASS AND PLASTICS LTD.
TORONTO · MONTREAL · WINNIPEG · VANCOUVER

CRYSTAL

**Plexiglas is a registered trademark of Rohm & Haas*



Why five plastics were used in one food mixer?

C.G.E. has discovered that in most instances a combination of plastics turns out the finest, yet most economical, finished product. For instance five different plastics properly molded were used to produce this popular food mixer.

There are many advantages in having C.G.E. solve your plastic molding problems. We have the facilities to fabricate any type of plastic material and the know-how as to what plastics to use. Call C-G-E Plastics Advisory Service. They will co-operate with your engineering, production and sales people to give your line added sales punch. Contact: Plastics Advisory Service, Canadian General Electric Co. Ltd., Cobourg, Ontario.

A — MOTOR ENCASEMENT in Hercocel Acetate. Fire and break-resistant . . . gleaming white finish. Resists food and fruit juice stains.

B — GASKET in Vinyl Plastic. Had to be exceedingly flexible. Resistant to oils and fats . . . easily cleaned.

C — EJECTOR LEVER in Urea Plastic. Very sturdy . . . in white . . . shows no wear though beaters are inserted and ejected constantly.

D — SWITCH BASE in Phenolic Plastic. Low cost . . . high dimensional stability . . . noted for its electrical properties.

E — CONTROL KNOB in Hy-impact Polystyrene Plastic. Very tough . . . in white . . . ideal for this part that is frequently handled. Low in cost.

Custom-Molded PLASTICS

Plastic Works — Cobourg, Ont.
INDUSTRIAL PRODUCTS DEPARTMENT

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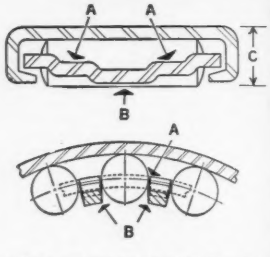
CANADIAN GENERAL ELECTRIC COMPANY LIMITED

Features of the new
TORRINGTON DRAWN CUP ROLLER BEARING



- rollers end-guided at pitch line (A)
- shaft-riding retainer (B) designed to permit lubricant circulation
- high capacity in small cross section (C)
- long pregreased life
- efficient at high speeds
- mounted by press fit
- simple housing design
- low unit cost

INTRODUCING

a new low-cost precision roller bearing...

THE TORRINGTON DRAWN CUP ROLLER BEARING

For the first time, the advantages of drawn cup outer race construction are available in a precision roller bearing.

This compact, lightweight bearing consists of spherical end needle rollers, a one-piece hardened steel retainer and case-hardened thin-section outer race. Designed to run on a hardened shaft or with an inner race, this new series takes a press fit in a simple housing without snap-rings or shoulders.

Highly efficient roller guidance and lubrication are outstanding features. The shaft-riding retainer contacts the roller ends at the pitch line where guidance can be obtained with the least effort. The design provides ample storage for lubricant and promotes its circulation.

These features make the new bearing particularly suited to applications requiring compactness with precision, high-speed endurance or long pregreased life.

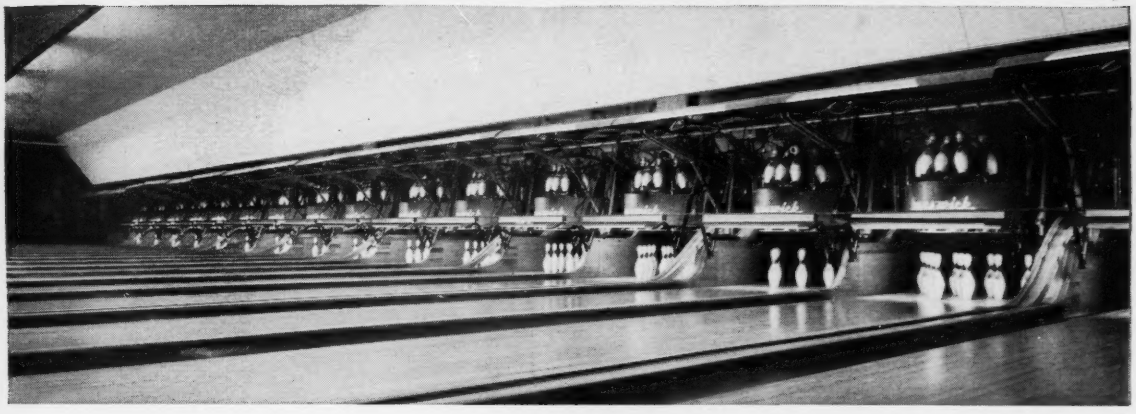
For information on sizes now available and for application assistance, call on our Engineering Department or write for the new bulletin, "Torrington Drawn Cup Roller Bearings." *The Torrington Company Limited,* 925 Millwood Road, Toronto 17, Ont., Canada.

TORRINGTON BEARINGS

District Offices and Distributors in Principal Cities of United States and Canada

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • THRUST • BALL • NEEDLE ROLLERS

"Brunswick finds RCI resin right down its alley!"



Tough, durable rake board for pinsetter made with

RCI POLYLITE

● The automatic pinsetter you see here increases the efficient operation of bowling alleys all over the country. Adds also to the fun and precision of the sport.

In designing this pinsetter, The Brunswick-Balke-Collender Company of Chicago needed a material with special properties for the rake board which clears the "deadwood" from the alley. The board had to be *light, smooth surfaced, tough and wear-resistant.*

Engineers at Brunswick experimented with RCI POLYLITE polyester resin and fibrous glass. They found they could produce a rake board with all the desired qualities by combining POLYLITE, glass fibre mat and outer layers of glass cloth to provide the smooth, wear-resisting surface.

"The most important reasons for our selection of Reichhold's Polyester Resin," say the Brunswick engineers, "were the requirements in this application of exceptional toughness and wear resistance."

Perhaps the combination of light-weight strength, durability and smooth colorful surfaces you get with RCI POLYLITE and fibrous glass construction can be incorporated into one of your products. Why not find out more about what *you* can do with RCI POLYLITE for laminating, molding and other applications? Write to Reichhold for *Booklet A.*

From large sheets of reinforced POLYLITE Brunswick cuts rake boards for its new automatic pinsetter. This close-up photo shows the light, wear-resisting rake board in action removing "deadwood."

Creative Chemistry ... Your Partner in Progress RCI

REICHHOLD

Synthetic Resins • Chemical Colors • Industrial Adhesives
Plasticizers • Phenol • Formaldehyde • Glycerine • Phthalic Anhydride
Maleic Anhydride • Sebacic Acid • Sodium Sulfite • Pentaerythritol
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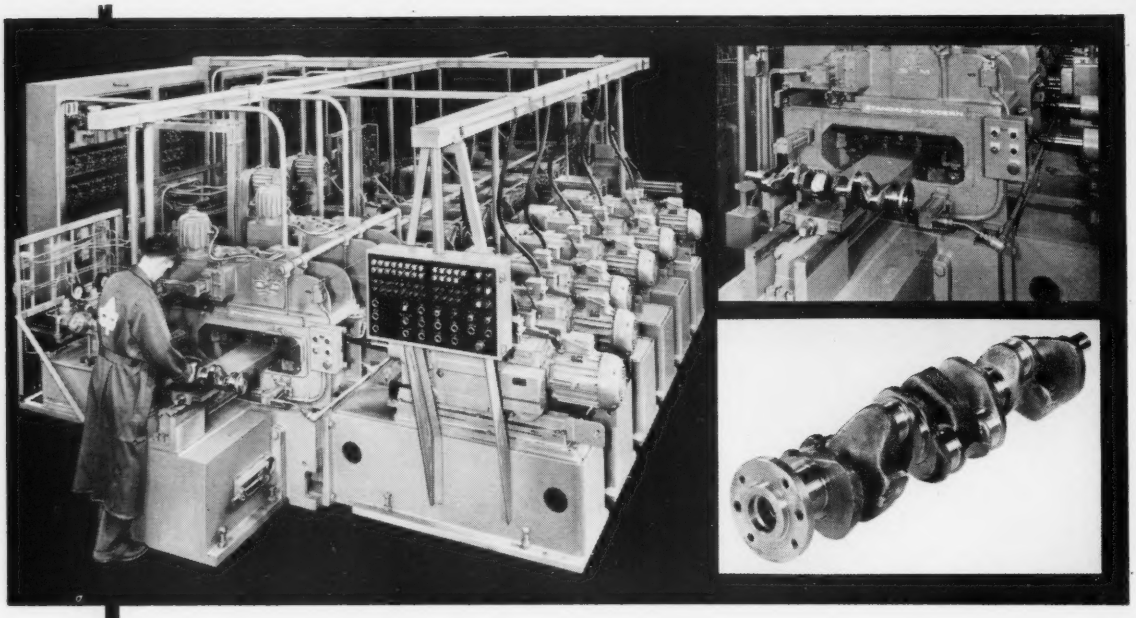
Another Special by **STANDARD–MODERN**



11-STATION TRANSFER MACHINE

performs 36 operations on six cylinder crankshafts

Turning out 60 crankshafts per hour at 100% efficiency, this Standard-Modern equipment combines operations never before accomplished on one "in-line" transfer machine.

Here is a summary of the operations involved:

- Drills, chamfers and taps 4 holes in flange
- Drills, chamfers and reams 2 holes in flange
- Drills, counterbores, reams and chamfers bushing hole
- Finish-bores bushing hole and faces flange
- Mills 2 keyways for timing gear and for pulley
- Drills, chamfers and taps hole in small end

Close tolerances of accuracy in transfer are guaranteed by hydraulic devices that lock shafts on hardened and ground locations on main bearings and crank pin.

The difficult flange boring and facing operation is accomplished by rotation of shafts on carbide locators by an hydraulic collet chuck at the small end. Damage from sudden start and chuck slippage is prevented by a device incorporating progressively increasing RPM.

A specially designed cutter maintains accuracy to within .0005″ in milling position of the keyways.

Other features include motorized track-type chip conveyors and magnetic separation in the coolant system.

***STANDARD-MODERN** Special Purpose Machines are speeding production, saving time and money for industry on four continents.*

STANDARD–MODERN
TOOL COMPANY LIMITED
MANUFACTURING DIVISION

69 Montcalm Avenue, Toronto, Canada • 3030 Walker Road, Windsor, Canada

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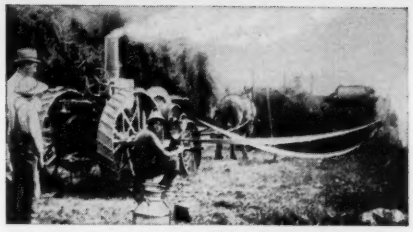
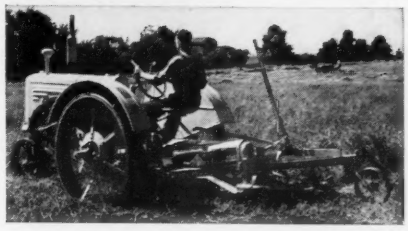
The belt drive p. t. o. stood still . . .



An early-day tractor—International Harvester.

Minneapolis-Moline built this one.

until the splined shaft p. t. o. took over . . .



A late model Allis-Chalmers.

. . . providing flexible power transmission to all implements equipped with adaptable

BLOOD BROTHERS Jointed Drive Lines

History was made when engineers first replaced the "pulley p.t.o." with the universal-jointed shaft. For this concept of flexible power transmission was the key to Progress. Implements that had, until then, remained stationary in the fields now moved forward. And the whole implement industry moved forward too—building innumerable new, better machines driven through universally adaptable, flexible drive line assemblies. Working with the manufacturers, Blood Brothers has kept pace—by building stronger, better drive lines for every farm implement requirement. If *you* build implements, consult Blood Brothers for helpful cooperation.

FOR FARM IMPLEMENTS, MORE BLOOD BROTHERS UNIVERSAL JOINTS ARE USED THAN ALL OTHER MAKES COMBINED

BLOOD BROTHERS
MACHINE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
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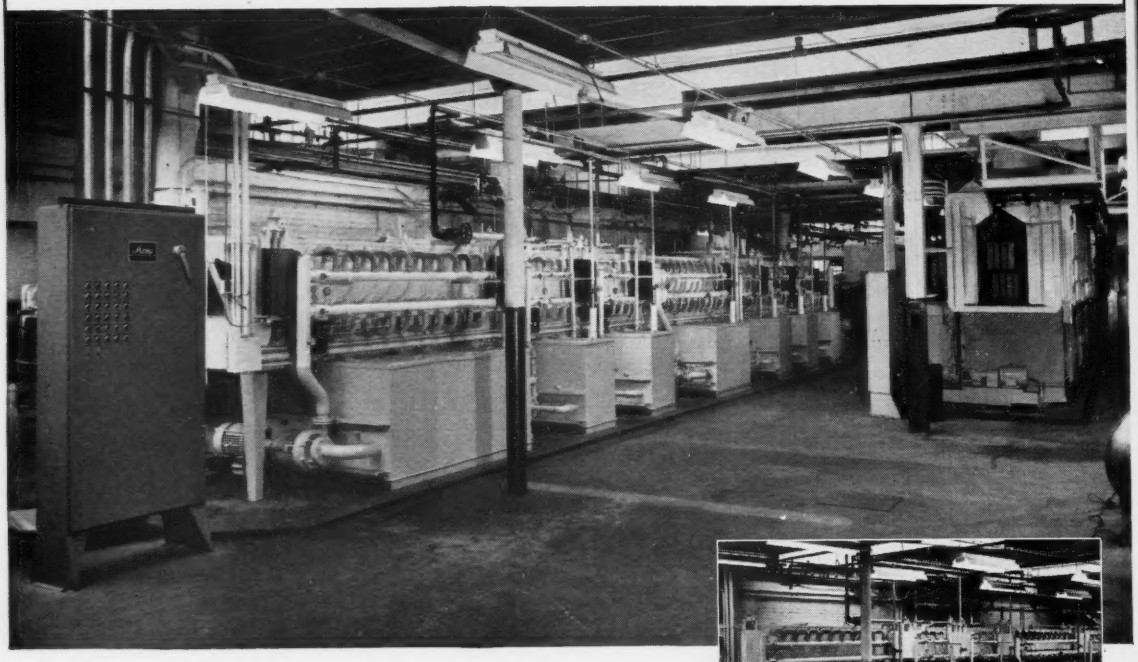
UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES

First in the Nation



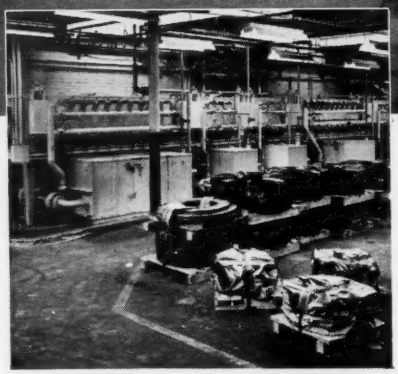
1. 75-foot continuous treatment strip machine, left, and automatic Spra Bonderite, right, in Parker's new customer service lab.

Now, for the first time in the industry, Parker Rust Proof Company brings you a way to test surface treatment of metals on a production line basis, *before* you install surface treatment equipment in your plant.

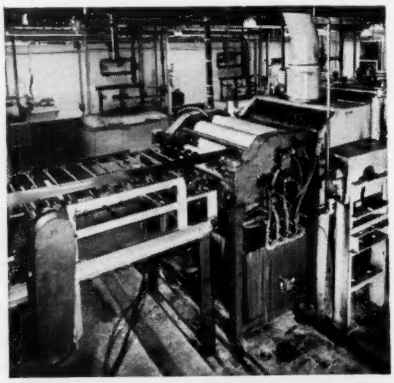
You can save time, trouble and money by making use of the extensive research facilities of Parker's unique new customer service laboratory. It's a research lab with production line equipment, run like a production line.

This automated lab can treat sample stock by the ton. It is equipped to prepare samples and conduct tests involving all of Parker's varied and outstanding surface treatments of metals.

If you have a metal surface treatment problem, you are cordially invited to make use of this new testing service. Just contact your nearest Parker representative, or write or call Parker Rust Proof Company.

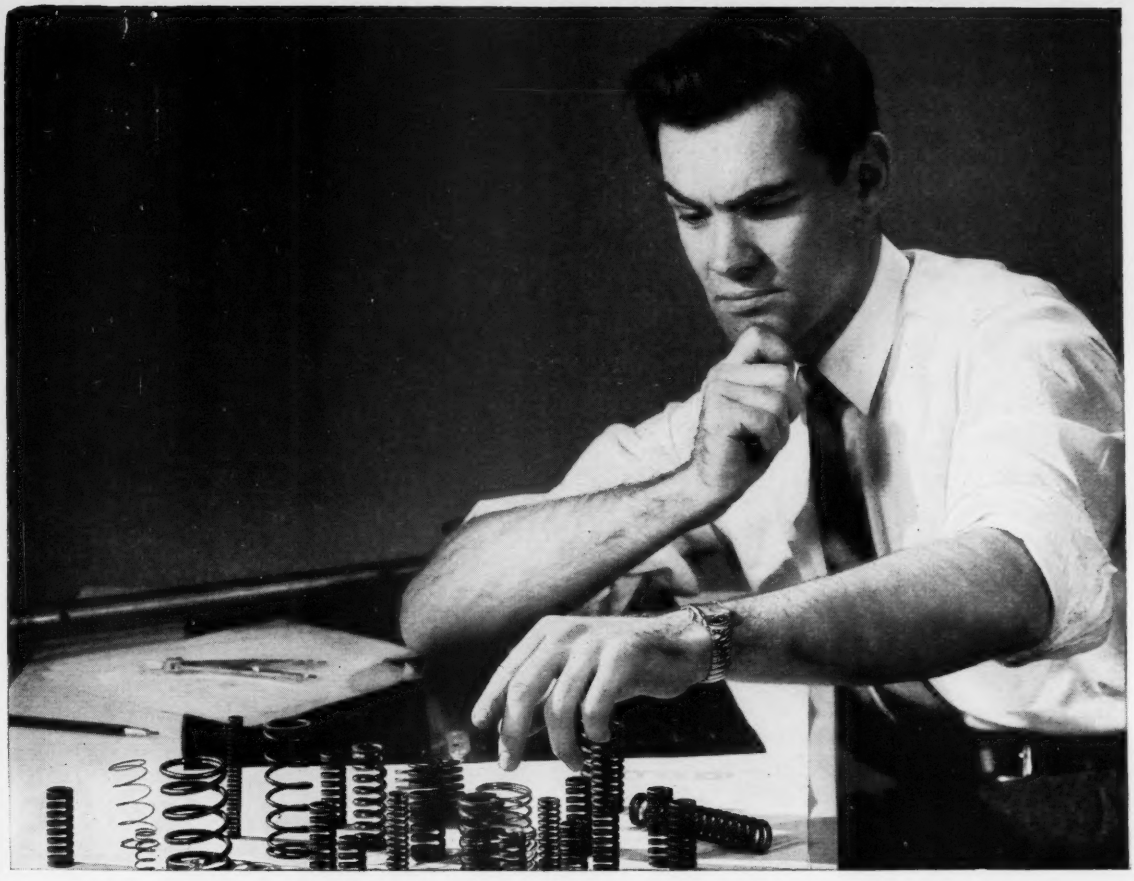


2. Tons of steel in coils await treatment in the strip and sheet treating machine.



3. Bonderlube is applied over Bonderite treatment for cold forming sample. Roller coating section at end of strip machine is interchangeable.

PARKER
RUST PROOF COMPANY
OF CANADA, LTD.
Rexdale Blvd., Rexdale (Toronto) Ontario
Since 1914—leader in the field



eeny-meeny-miny-mo ?

Guessing games are expensive in specifying springs. Very often, springs *look* alike, but each is different because each is designed to do a specific job.

Why risk the expense of designing springs yourself? Wallace Barnes have a background of over 500 man-years of engineering experience in solving problems of type, size, tension, temper, stress and other complicating factors. Let our spring engineers accept your precision mechanical spring problems and help design just the right spring to meet your requirements.

Send for your free copy of
Spring Design and Selection—in Brief
our authoritative digest on spring engineering

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Springs must be precisely right!

JUST CALL THE  MAN FROM

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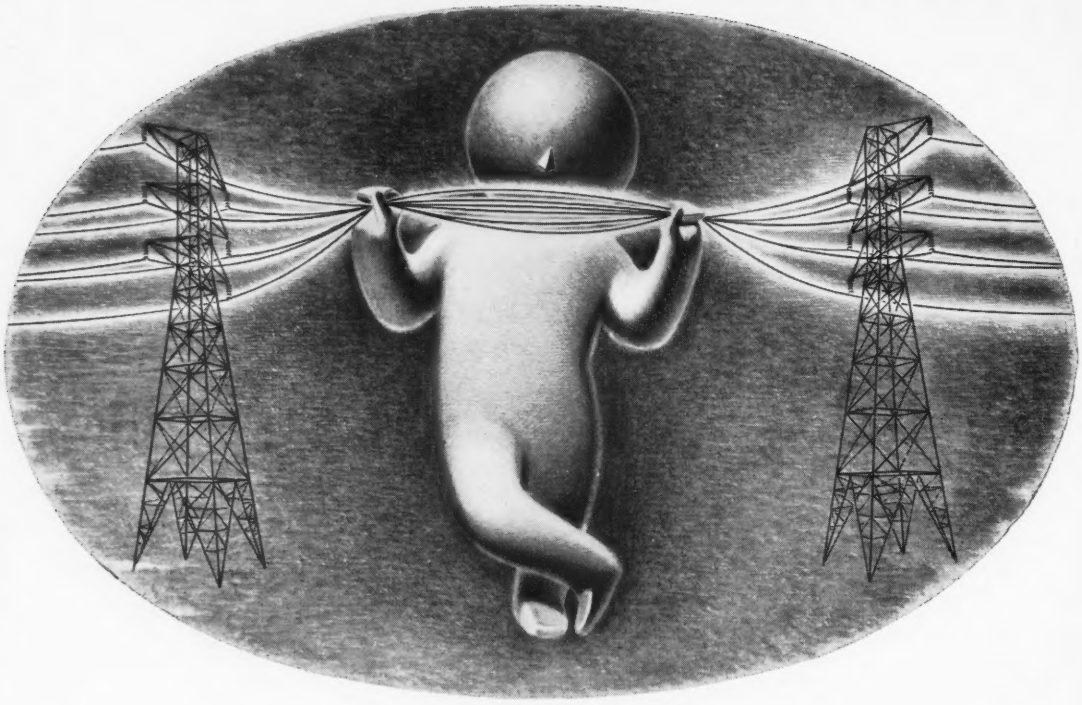
How can you benefit from the amazing

ELECTRICAL PROPERTIES

of G-E silicone rubber AT HIGH TEMPERATURES?



Amazing electrical properties at high temperatures are among the outstanding characteristics of General Electric silicone rubber. It is ideal for wire and cable insulation where overloads or space limitations dictate a heat-resistant dielectric. Cables have been redesigned with G-E silicone rubber to carry nearly *twice the current—with no increase in size!* G-E silicone rubber not only provides Class H insulation, but can be used to improve Class B insulation as well.

Where can YOU use G-E silicone rubber? There's a kind for almost every requirement, classified according to dominant property for easy selection and specification. For example: Class 300 offers the best recovery after compression *of any known rubber!* Class 500 provides flexibility *at 130°F below zero!* Which class is best for *you?*

SEND FOR A FREE "LIGHTNING SELECTOR"—TODAY!

G-E SILICONE RUBBER PROVIDES...

Outstanding resistance to extreme temperatures

Superior resistance to compression set

Dielectric strength stable at high temperatures

Unequalled resistance to aging, ozone, weathering

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INDUSTRIAL PRODUCTS DEPARTMENT

CANADIAN GENERAL ELECTRIC COMPANY

LIMITED

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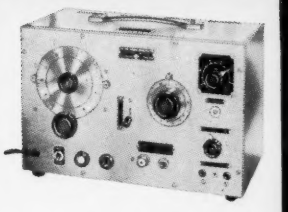
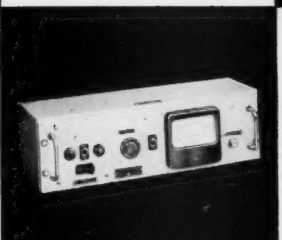
City_____ Prov._____

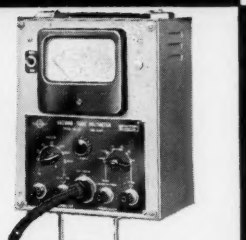
457W-656



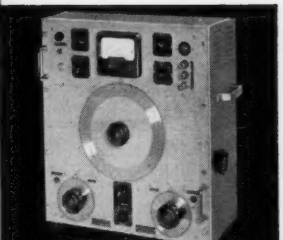
SIGNAL GENERATOR
MS 25



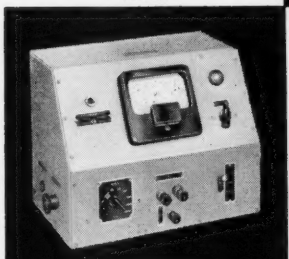
NOISE GENERATOR
TYPE DSG 1



VACUUM TUBE VOLTMETER
TYPE RV 13

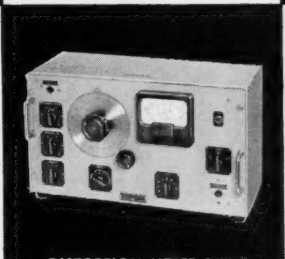


BEAT FREQUENCY
OSCILLATOR HO 12



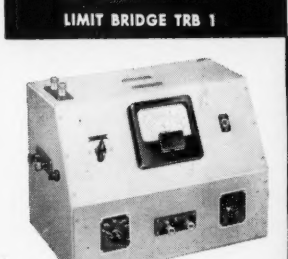
LIMIT BRIDGE TRB 1

AM STANDARD SIGNAL
GENERATOR TYPE MS 15



DISTORTION METER BKF 5

CAPACITANCE BRIDGE
TYPE CMB 1



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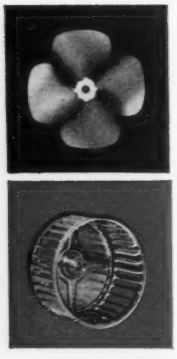
NEW & NEW & EQUAL NEWS



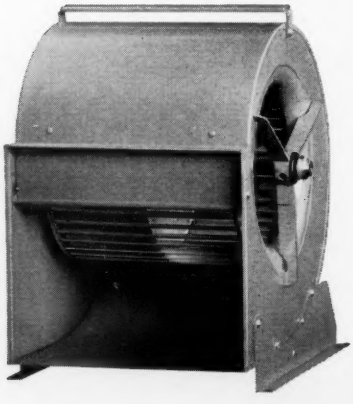
It's the *new* Torrington line of Vari-Basic blower units for central heating and air conditioning equipment, now in production at all three Torrington plants. And here is why this important product development is *news.*

1. New quality: Engineering features include the famous Center-Lock Airotor wheel design . . . permanently plastic lubricated Randall bearings, with 3-point suspension . . . and spot-welded heavy steel construction, superbly finished.

2. New flexibility: The units are designed for interchangeability with existing standard equipment, and Torrington's marketing policy makes these components available singly or in combination.

3. New versatility: These units are available in a wide range of sizes designed to provide maximum variability to meet directional-flow requirements.

Your inquiries are invited. For full information, *talk to Torrington!*



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People

Important people who are in the news

Russian speaker

Mr. E. I. Tolstikov of the USSR will talk at a world gathering of scientists in Toronto on the subject of arctic and antarctic investigation of the International Geophysical Year. His illustrated address will be given at the eleventh general assembly of the International Union of Geodesy and Geophysics which meets in Toronto, September 3 to 14, 1957. Mr. Tolstikov is deputy head of the Russian Central Department for the arctic seaway by which ships pass north of Siberia from European Russia to the Bering Sea and Pacific Ocean.

CAE appointment

The appointments of **R. W. Cooke** as vice-president engineering products, and of **C. J. Konzuk** as general manager, eastern division, have been announced. The new positions were created to support the company's expansion in the military and commercial electronics field.

Mr. Cooke has been with Canadian Aviation Electronics since 1952 as assistant chief engineer. Mr. Konzuk joined CAE in 1951.

Ross is assistant manager

The appointment of **J. W. Ross, P.Eng.,** as assistant manager, Development, of Linde Air Products Company, division of Union Carbide Canada Limited, has been announced.

A graduate in mechanical engineering from the University of Toronto, Mr. Ross joined Linde in 1944. His work in the development and application of all the newer welding techniques and processes has brought him in close contact with heavy industry on this continent. Prior to his new assignment, he was assistant manager, engineering.

New office

Russell A. Philpott, eastern Canadian representative for the Wallace Barnes Company Limited, a subsidiary of Associated Spring Corporation, is in charge of the new Montreal sales office which has just been opened.

Winnipeg manager

James E. Scotten has been appointed manager of the Winnipeg district office of Canadian Allis-Chalmers. Mr. Scotten, who joined the company in 1951 as a sales engineer, was transferred the following year to the Winnipeg office. He is a graduate of the University of Manitoba.

Batler of Philips

The appointment of **Mr. Emmanuel Batler, B.Sc.,** as manager, professional products division, was announced last month by Philips Industries Ltd. Mr. Batler will direct the expanding marketing program of Philips' scientific, industrial and medical apparatus division. Mr. Batler was formerly general manager of Cushing and Nevell Limited and has had broad experience in technical and business areas in both the U. S. and Canada. He settled in Canada in 1952.

Curtin is techrep

Bakelite Company, Division of Union Carbide Canada Limited, announces the appointment of **Mr. Gordon Curtin** as technical representative. Mr. Curtin is a graduate of Macdonald College with a B.Sc. degree.

Four at National Carbon

New appointments to the development organization of National Carbon Company, division of Union Carbide Canada Ltd., have been announced. **Mr. W. A. Dimma, B.A.Sc., P.Eng.,** is appointed manager of the development organization. **Mr. W. L. Kennedy, B.Sc.,** and **Mr. H. L. Tipple, B.A.Sc., P.Eng.,** will be responsible for the development of new products while **Mr. H. M. Brown, B.A.Sc., P.Eng.,** laboratory director, continues in charge of existing products and process developments. The purpose of this group is to investigate and develop new products to be manufactured or marketed by National Carbon.

Honeywell appointment

Gordon Stapleton has been appointed factory contact engineer of Honeywell Controls Ltd.

A graduate in mechanical engineering from the University of Toronto in 1955, he has been handling the design liaison section of factory contact work for Honeywell. He joined Honeywell in May, 1956 from Dunham-Bush (Canada) Ltd.

Peacock appointments

Peacock Brothers Limited has recently announced two appointments. They are **Ian G. Wilkie** as general works manager and **C. S. LeClair** as chief engineer of

LeClair

Wilkie

the company's new project and development department.

Prior to his latest appointment Mr. Wilkie was manager of the test plant and assistant to the president of the company on manufacturing and testing. Mr. LeClair directed his own consulting business in Toronto.

Honeywell sales supervisor

Jerry Sedgley has been appointed sales supervisor, Industrial Division, Central Region of Honeywell Controls Ltd.

Mr. Sedgley will assume the duties of Ray Hoover, who retired from the company on April 1, 1957. His responsibilities will include the co-ordinating of the Industrial Division's activities throughout Ontario.

A Honeywell employee since 1949, Sedgley is a graduate in mechanical engineering from the University of Toronto and was an RCAF Pilot Officer during World War II.

Brown

Curtin

Dimma

Kennedy

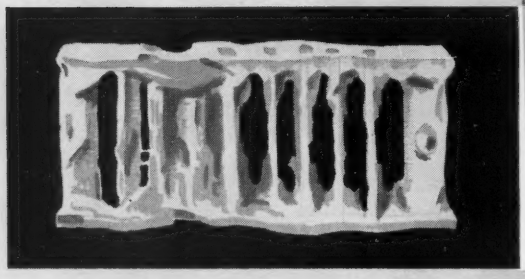
Ross

Tipple

INCO CUSTOMER SERVICE AT WORK

High Temperature Service

Test racks are used by Inco engineers to determine the effects of high temperatures on alloys. Below is a test rack after exposure to heat conditions in industry. From a study of this, Inco engineers are able to recommend the best alloys for specific operating conditions. If you have high temperature problems, this service will prove useful to you.



another example of the way Inco Research helps solve your metal problems

Inco has tested many metals and alloys for high temperature performance over a long period of years. Already a vast fund of such information has been accumulated. Through Inco Customer Service, this is available to you.

A High Temperature Work Sheet, *copies of which are available to you on request*, has been prepared to make it simple for you to outline your high temperature problems. With it, Inco engineers can give your problem careful consideration. If the data already on file are not sufficient to provide a solution, further tests will be conducted. Engineers are available for consultation and on-the-job assistance.

Inco Customer Service stands ready to help you solve other metal problems. We invite you to call on us for information involving welding and fabrication, foundry practice, metals selection, high and low temperature service, mechanical and physical properties and performance characteristics. That's why we say:

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TRADE MARK

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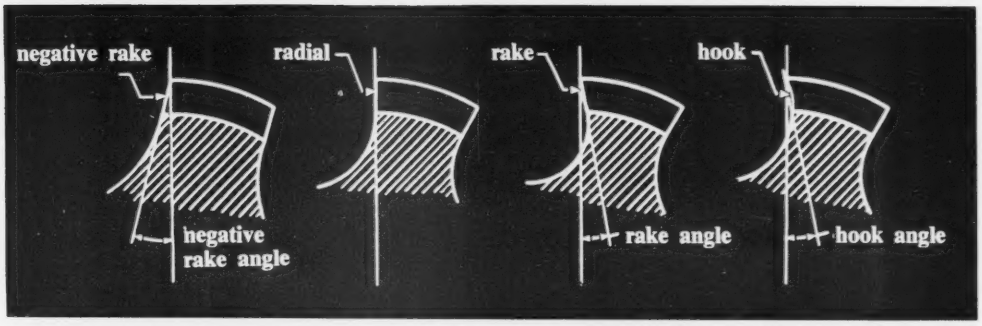
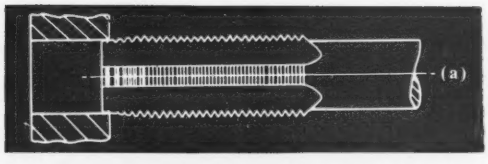


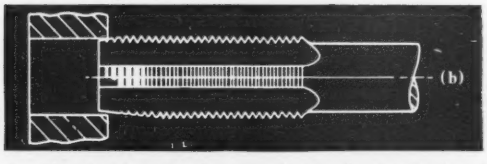
1. There are four designs of cutting face that may be incorporated in tap designs, namely, negative rake face, radial face, raked face and hooked face. The four designs are shown in above illustration.

A blueprint for designing a thread tap

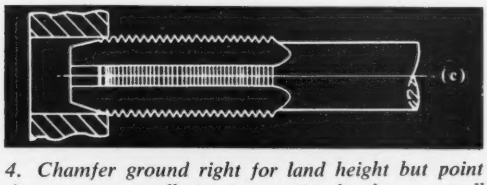
Armed with a fresh approach the athor tackled a sagging tap business



2. Chamfer correctly ground. All lands of chamfered portion in contact. Point diameter large enough to permit only one thread to enter thus obtaining full cutting benefit of practically the entire chamfer.



3. Chamfer incorrectly ground. Lands of chamfered portion are uneven as to height, thus forcing the entire cutting burden on lesser number of lands. Result: poor threads, tap breakage, power waste.



4. Chamfer ground right for land height but point diameter too small, forcing cutting burden on small portion of chamfered section. Result: a shorter tap life due to dulled cutting edges and power wastage.

R. C. Stewart VANADIUM-ALLOYS STEEL CANADA

For many years, tap manufacturers have recognized the importance of standardizing screw threads and thread cutting tools. Evidence of this is the adoption and wide publication of standards designed to benefit all industry.

Better gauging and inspection of screw products has, for example, recently resulted in the consolidation of "Commercial Ground" and "Precision Ground" into one standard, thus effectively narrowing down the spread in fit tolerances to one half the original limits. In other words, all ground thread taps today are equivalent to the old precision ground with respect to limits.

Resulting from this tightening of limits has been the greater use of close fits, statistical methods of inspection in the manufacturing of components, and far greater use of interference fits in hydraulic systems and the like.

It would be well to stress at this point, however, that a tap manufacturer cannot guarantee the size of the tapped hole that will result from the use of his taps; his literature can only state within what size limits his taps will fall. And this is all that is claimed by the tap manufacturer.

The size of the threaded hole is dependent on various operating conditions, such as the equipment used, the material being tapped, size and condition of the hole, speed of operation, alignment, lubricant used and so forth.

Having been assigned the task of rebuilding a

sagging tap business, a start was made by the author to see how the subject compared with the trade in general.

On production taps, a great deal of deviation existed among tap manufacturers with respect to adherence to basic principles. In some of the taps examined there was much lack of symmetry, bad indexing and the like, many suggesting freehand methods of fluting, squaring, pointing and so on.

Some of the shanks had coined squares, and there appeared to be no agreement as to whether male or female centres were best.

Producing good blanks was our first consideration, and much effort was spent in developing automatic tooling capable of producing good centres and step-down turning that was concentric.

Flute milling fixtures were required for multiple milling of flutes. These were required accurately to index the tap blanks to produce uniform symmetrical flutes regardless of number.

Ample support had to be provided to avoid distorting the centres, from which all final grinding is done.

In flute milling consideration was given to flute depth to provide optimum chip room without thinning the web extensively and thus weakening the tap. It is in consideration of this requirement that three and two flute taps are produced. Having fewer flutes, more chip space is provided and freer passage of the chips allowed.

Two types of flute

Spiral point taps (or gun taps, as they are often called) are a special development from the above reasoning. They are strictly a production tool, not intended for hand use. In these taps the flutes are divided into two sections:

(1) The conventional straight flute, generally, however, much shallower as they are not intended for chip passage. Being shallower (and hence thicker) they are much stronger.

(2) An angular section at the point (called the spiral point or flute) and having a cutting face A (see fig. 6) ground to a predetermined angle B relative to the axis of the tap, enabling the tap to cut with a shearing action (that is, with the least amount of thrust). The angle B deflects the chips so that they curl out and ahead of the tap (see fig. 5).

After fluting, the blanks are ready for hardening. As most production taps are made from high-speed steel, salt baths are the best selection for heat treatment.

Since our purpose was at the outset to produce a better tap, considerable study was made of the various high-speed steels that were available and considered suitable.

It was felt that, since taps that are not accidentally broken eventually wear undersize by abrasion and rubbing (and thus finally produce holes outside the tolerance) exploration of some of the newer high carbon, high vanadium types of high-speed steel should prove worth while. Finally decided upon was M4 (a patented composition manufactured by Vanadium Alloys Steel Co.), having the following nominal composition:

Carbon	1.27%
Tungsten	5.50%
Chromium	4.50%
Vanadium	4.00%
Molybdenum	4.50%

In the normal hardened state this steel retains a large amount of vanadium carbide particles uniformly distributed throughout the steel. This vanadium carbide is much harder than the carbides usually found to be present in conventional high-speed steels.

Naturally, the grinding of such a particularly hard material was expected to prove difficult, but fortunately it did not prove impossible.

After hardening, the centres were carefully lapped to provide good bearing surfaces. Incidentally, the angles on the machine centres should be slightly less than their female engagements on the tap blanks. The male centres should also be truncated, thereby permitting an annular ring contact between work centres and tap blanks. This provides a rigid mount keeping the tap solidly against the grinding wheel.

More horsepower is required to drive the grinding wheel, but apart from that, no special care was necessary in grinding, as long as the wheels were kept sharp and free cutting, and the usual care was exercised to avoid grinding burn.

As most production taps are of the spiral point variety, much care was given to the flute polishing to maintain symmetry and maximum strength. It is of interest to note here that a great fallacy exists regarding the rigidity of taps (that is, their resistance to whipping or twisting elastically). The property of stiffness involves the Shear Modulus (G). Stated simply, it prescribes that within the elastic range, the modulus does not change with heat treatment or composition within the usual composition ranges of steels suitable for tap manufacture. The only way, therefore, to stiffen a tap that is felt to be too springy, is to increase its cross-section. It

Hardness of various substances

Material indented	Knoop hardness (K25) average	Knoop hardness (K25) range	Number of indents
Oil hardening tool-steel	790	770- 800	4
Cementite in carbon steel	1150	1060-1240	8
Complex chrom-iron carbide in high carbon, high chrome steel	1820	1690-1960	7
Aluminum oxide (alundum)	2440	1900-2920	19
Complex vanadium carbide	2540	2340-2760	8
Silicon carbide	3590	3070-3980	200

5. Perfect action with a spiral point tap. Note how the chips twist around each other indicating that there is uniform loading on each of the lands.

is for this reason that spiral point taps are so desirable for production work.

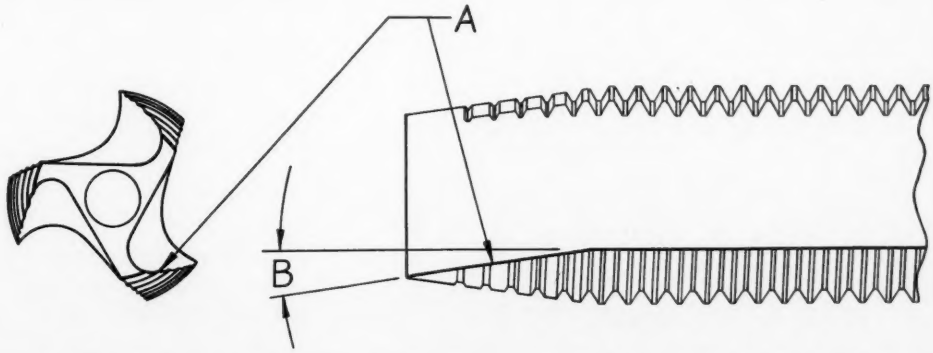
In this type of tap, all the cutting is done by the spiral point and here then was one of the focal points for improvement.

Chamfering was done on special fixtures to provide eccentric relief for adequate clearance. On resharpening, the grinding is done from the spiral end, driving the spiral point further and further back rather than by face grinding, which would reduce the effective diameter.

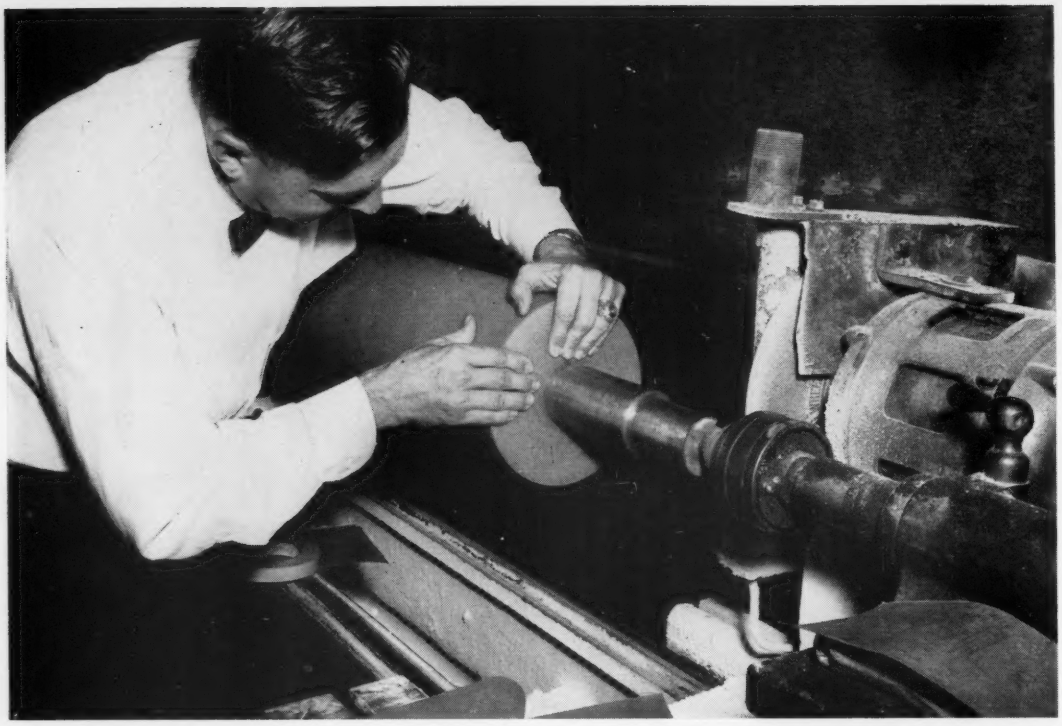
In cutting, since the chips flow laterally over the spiral point or flute, it was decided to grind this portion along the direction of the chip flow, rather than down the axis of the tap, as is usually done.

This necessitated developing a new technique using pencil wheels and freehand grinding. Because the grinding marks were parallel to the chip flow, very favorable chip flow was obtained, with extremely low chip pressure, and virtually no chip pickup on the spiral point.

(Continued on page 80)



6. Cutting face A has been ground to predetermined angle B relative to the axis of the tap.



1. Experiments show distinct advantages for the new silicone rubber, especially in production of newsprint.

Silicone rubber can do more than ever

Improvements keep coming fast. One is in the basic polymer structure

By G. R. Ball BAKELITE COMPANY

During the past ten years, product designers have accepted silicone rubber as a useful engineering material. This acceptance came about because of its outstanding properties: excellent resistance to oxidation, ozone and other chemicals; high electrical insulating values; good release from sticky materials over a wide temperature range; flexibility and long life at extremely high and low temperatures; high thermal conductivity.

How does this new gum stock help?

New uses for silicone rubbers are now possible because of recent developments. Compounds made with a new silicone rubber gum stock do all that previously-known silicone rubbers would do, as well as having many striking advantages. The use of this gum does away with many of the special compounding and curing techniques so necessary with conventional silicone rubbers. This could lead to a reduction in the cost of silicone rubber products.

These properties were just what designers needed for such diversified uses as oven door and aircraft door gaskets, hot oil pump seals and O-rings, electrical wire and cable insulation and many other products where temperature extremes are met.

During this time, researchers were of course trying to improve the properties of silicone rubber to extend its uses into new fields. Until recently, any improvements that had been made were through filler and compounding variations applied to the conventional dimethyl silicone gum systems.

Union Carbide scientists tried a new approach. They worked on changes to the basic polymer structure and came up with this radically different silicone rubber gum stock. The improved properties have resulted in important new uses for silicone rubbers.

So significant is this development that many authorities believe the straight dimethyl gum stock (the original backbone of conventional silicone rubber) is on the verge of obsolescence.

The secret of the particular properties of the new gum stock and its compounds is that a controlled number of reactive vinyl groups have been built into each silicone molecule. These groups determine the final structure of the cured rubber. It is this "controlled reactivity" that gives dramatic advantages in compounding and curing the rubber, as well as imparting special properties to the cured product. These new vinyl gums

can be cured with a new selective catalyst or any of the usual silicone rubber-curing catalysts.

Some of the significant advantages are:

(a) solid, rapidly post-cured, thick sections;
(b) new low values in compression without using toxic or volatile additives;
(c) exceptional resistance to high pressure steam;
(d) conductive silicone rubber possible using carbon black fillers;
(e) retention of the minimum of catalyst residues.

Typical applications

A few examples follow of the way the new gum stock and its compounds can expand the use of silicone rubber into quite different fields.

Rolls. One of the major uses is in rubber-covered rolls. This potentially large field opens for the first time to silicone rubber because of the thick-section curing feature of "controlled reactivity" gums. Conventional silicone rubbers could not be successfully cured (or vulcanized) in thick-section moldings.

There are many places where the outstanding nonsticking properties of silicone rubber, or its unsurpassed thermal stability, have been required in rolls and are now obtainable through the new gum. These include the paper, textile, plastics, graphic arts, glass and metalworking industries.

The first time that a silicone rubber-covered roll was ever used on a paper machine took place earlier this year at the School of Paper-Making in Three Rivers, Quebec. This roll was built by American Wringer Company using compounds made with the new silicone gum. The roll (34 in. long by 12 in. diameter) was used on the school's experimental paper machine in the top press position. Results of this experiment were highly successful and showed the distinct advantages of silicone rubber over the usual roll coverings, especially in newsprint production.

The excellent release qualities of this silicone roll were particularly noticeable. As a result larger rolls are being built and full-scale mill trials at newsprint mills are in prospect.

Conductive Rubber. For the first time too, conductive silicone rubber compounds can be made by mixing the "controlled reactivity" gum with conducting carbon blacks. The product combines the particular properties of silicone rubber with the highest degree of electrical conductivity now commercially available in a flexible thermosetting material.

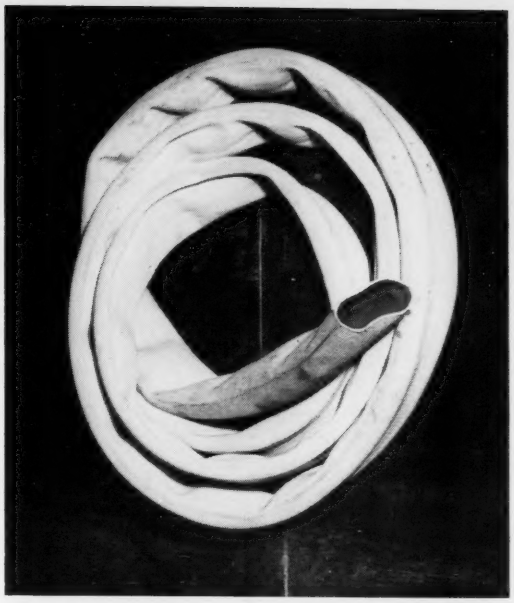
Heaters of various kinds can be formed to any shape. These heaters resist mechanical shocks or blows fatal to brittle materials like graphite and ceramic. Heating elements formed from this new compound have been continuously operated as high as 400 F for moderate periods of time, without significant deterioration of desirable properties.

The material can be extruded as electrically conductive tubing or hose. Its ability to drain static charges and prevent sparking makes these products of interest in handling inflammable or explosive gases or dusts, and in sand blasting.

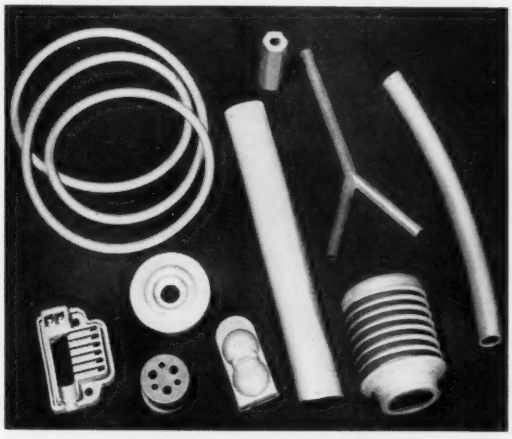
Electrical conductivity in a roll covered with this silicone compound provides a way to dissipate static electricity, heat the roll surface or both.

Another use is to provide an electrical conductive shield for silicone insulated electrical equipment or other

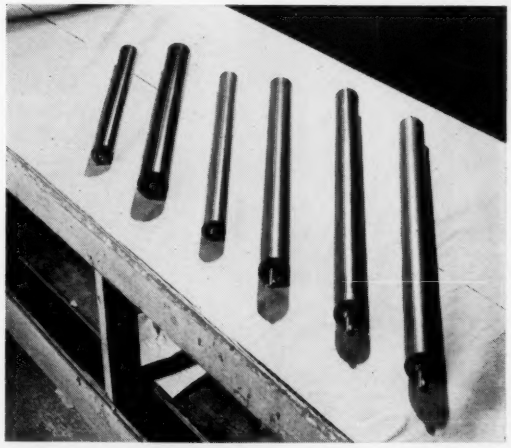
(Continued on page 52)



2. This hot air hose has a lining of silicone rubber.



3. Parts moulded and extruded from silicone rubber.



4. Some of Union Carbide's new silicone rubber rolls.

"Development of a 'controlled reactivity' gum is a striking advance"

5. Research must be a continuous process for progress.

types of equipment operating at high temperature; and also in the construction of special power transmission beltings, where spark discharges are hazardous.

Other possibilities for special applications of this compound include: anti-fogging heaters in aerial cameras, aircraft and marine instruments and anti-static conveyor belts.

By simply blending these carbon-black-filled compounds with silica-filled silicone rubber compounds, a whole range of different conductivities can be obtained for specific applications.

Formerly silicone rubbers took a high permanent set when compressed at high temperatures. This difficulty was partially solved by adding special fillers (such as oxides of mercury) to the conventional dimethyl silicone rubber compounds.

The new gum gives even lower compression set values without these toxic additives. Sets of 15% can now be obtained, as compared with 82% with conventional silicone rubber compounds. This means better products and no worry about the health hazard of the toxic additives.

New uses are opening in foods, drugs and pharmaceutical manufacture, because inert products are needed there with good low compression set.

Conventional silicone rubbers were excellent for low and high temperature service, having a useful temperature range when compounded from —120 to 600 F.

The new gum permits an even wider range of temperatures. One special low temperature compound has been developed that remains flexible (and keeps its elastomeric properties) down to —150 F.

Although previous silicone rubbers were excellent for high temperature service, the extreme 600 F high temperature resistance and low compression set of certain of the new compounds have opened new fields for rubber in press pads and heater ducts.

Prior to "controlled reactivity" gums, silicone rubber failed in high pressure steam service. Compounds based on a new gum retain their properties on exposure to 100 lb. steam, whereas a typical dimethyl silicone compound is rapidly degraded. This means that the excellent thermal stability of silicone rubbers can now be used without serious degradation in high temperature steam gaskets, hoses and other seals.

In many sealing applications, silicone rubber is in contact with hot oil or solvent. The improved oil resistance of the new gums is being made use of in the automobile industry for transmission seals, and further extension of this type of seal is foreseen in railroad applications.

Future outlook

The development of the "controlled reactivity" gum is a striking advance in silicone rubber technology. It means that new compounds for thick sections with lower compression set, greater steam and oil resistance and with amplified vulcanized schedules are now available.

Improvements in these new compounds are imminent as further gum modifications are made and more fabricators develop new compounding techniques. From all this, important new uses for silicone rubber have resulted. Many additional applications will be uncovered as product designers experiment still further. ★

Where to Use Conducting Silicone Rubbers

The new silicone rubber compounds, filled with conduction carbon black, are suggested for uses where:

1. An electrically conductive rubber is required to operate at higher or lower temperatures than are possible with other rubbers.

2. High stability of electrical conductivity during processing is required.

3. Uniformity of electrical conductivity throughout a product is desired.

4. A series of compounds with various electrical conductivities is needed.

5. Difficult problems in fine profile extrusion are encountered and electrical conductivity is either required or is important.

6. The non-sticking properties of silicones are needed with good electrical conductivity.

Could powder metallurgy benefit you?

It's a process that takes complex periphery contours in its stride

By George G. Karian F. J. STOKES CORPORATION

The variety of shapes into which powder metal parts can be made is very great. Any contour of the periphery (however complex and whether internal or external) is as perfectly suited to powder metal processing as it is unsuited (or costly) to forming by other methods.

Sharp variations in thickness in the direction of pressing should be avoided. Such variations may make the unsintered pieces difficult to handle and are likely to set up severe strains when sintered. Further, they require presses equipped with complex motions. When extreme variations in thickness cannot be avoided, they may to a great extent be offset by corrective variations in opposite positions. Thus (by redesigning) a deep annular groove on one side of a piece may be offset by a corresponding ridge on the opposite side.

Variations in final dimensions of powder metal parts are due to die tolerances, die deflection, shrinking or swelling during sintering and certain other causes. They are greater with low density pieces than with high density pieces. They are less with symmetrical parts than with unsymmetrical parts. Distortion can often be anticipated when designing powder metal parts and can be offset by proper allowances in making punches and dies.

Radial (side to side) tolerances of ± 0.003 in. and axial (direction of pressing) tolerances of ± 0.005 in. are easily met. On some materials, tolerances of ± 0.001 in. are fully practical. Tolerances as low as ± 0.0005 in. can be met by sizing (re-pressing after sintering) but this is an additional operation and such close tolerances should not be sought unless absolutely necessary.

Designing for powder metals

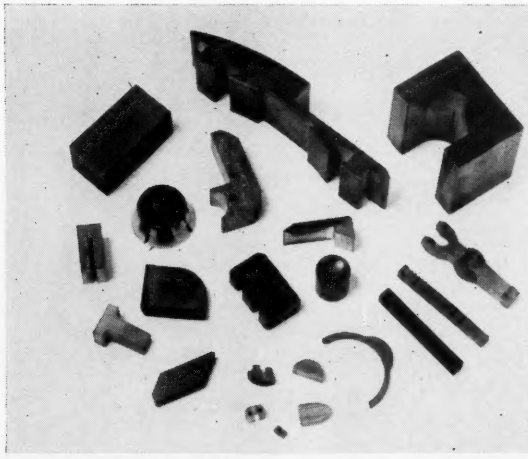
Many of the current standards and qualifications relating to powder metal design and manufacture are here set forth for the guidance of design engineers interested in powder metal processing.

Often, a moderate change in design (without change in specification) will be sufficient to adapt a part to the powder metal process and offer a practical compromise between a design which, on the one hand, is ill-suited to powder metal and, on the other hand, is too expensive to produce by any other method.

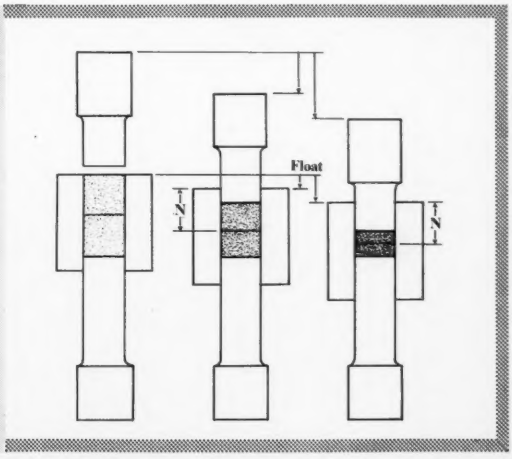
Manufacturers of metal powders, powder metal presses and sintering equipment (and custom manufacturers of powder metal parts) are always glad to offer a specific appraisal of the suitability of a given part to powder metallurgy.

Practically every piece that is now being commercially produced of powder metals can be classified into five general types, with a few variations:

Class I. The simplest pieces that can be formed by pressing are those with two flat parallel faces (Fig. 1) These pieces are made by flat face punches and can be pressed by pressure from above only, by pressing from



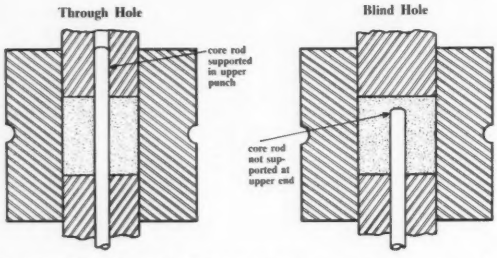
1. Parts with two flat parallel faces are simplest to powder metal form. They are made by flat face punches.



2. A floating die table and a stationary lower punch are shown here filled, at half and full compression.

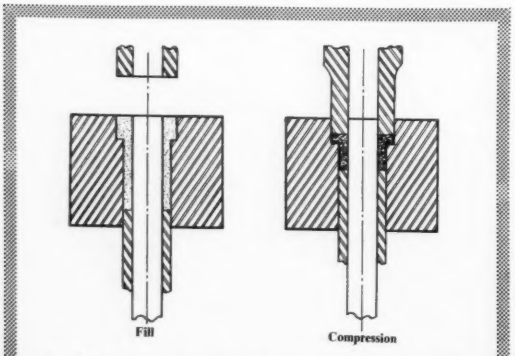
The versatility of powder metallurgy

3. Powder pressings made around stationary core rods.



4. Principle by which the parts shown above are made.

5. Parts with an external flange made by upper punch.



6. Body is pressed between the two punches.

above and below, or by a floating die with a stationary lower punch (Fig. 2). The double-action pressure from top and bottom tends to give more uniform density. The action of a floating die table and a descending upper punch can produce the same compressive forces as are obtained with dual action, with pressure from the top and bottom.

Class II. The next group consists of similar pieces which have one or more holes through them parallel to the direction of pressing (Fig. 3). These pieces are made by pressing the powder around stationary core rods (Fig. 4). The top of the core rod is set flush with the die and the top punch has a mating hole into which the core rod enters while the powder is being compressed. For making thin-walled bushings, the core rod is withdrawn before the filling operation and pushed back into place before pressing. The timing is such that the downward motion of the core rod occurs before the pressed piece is ejected, thus reducing the ejection load as well as assisting in the filling operation. Odd shapes and multiple core rods require more complicated die design, but the principle of operation is the same. Tapered sections may also be included.

Class III. The next type of part is the piece with an external flange, made with or without the movable core rod (Fig. 5). The flange is formed by the upper punch pressing against the shoulder in the die, while the body of the piece is pressed between the two punches (Fig. 6). As the powder will not flow from the flange section of the die into the body section, the depth of the flange section must be carefully predetermined or a provision made for adjustment of the shoulder. Flange pieces require a spring mounted upper punch (or a spring section under the flange) so that the upper punch can close the die before the motion of the lower punch pushes powder out of the die. To avoid spring die sections or hydraulically floating die sections (which may prove troublesome) many of the cam presses are equipped with cams giving nonsimultaneous pressure. The upper punch descends and closes the die before the lower punch moves. Near the end of the compressing cycle, the upper punch moves down a small additional amount to strengthen the flange.

Class IV. Pieces with an internal flange (Fig. 7) are made in a similar manner, using a shouldered core rod instead of a shouldered die. Nonsimultaneous motions or spring members are required, similar to those for external flanges.

Class V. Pieces with different pressing levels, such as step flanges or double hubs (Fig. 8), require additional punches (Fig. 9) or additional spring sections. Special cam motions are sometimes required to prevent breakage of pieces with thin sections or thin flanges, when starting to eject. In such cases, the cams are so designed that the two lower punches start moving upward simultaneously (maintaining their same relative pressing positions), to break the piece free from the die wall and continue ejection until the lower punches are level with the top of the die. In some instances it is possible to have the lower punches leveled in the die after over-

coming the initial resistance to ejection, thus permitting the piece to be ejected. Problems also arise in connection with the removal of complicated pieces from the die or from an irregular punch face after ejection from the die. When the lower punch projects above the die table for the purpose of ejection, it would normally interfere with the feed shoe mechanism. This may be overcome by adding an extension to the face of the feed shoe which is raised so that it pushes the finished piece away before the shoe itself reaches the die. After ejection, the forward motion of the feed shoe is then delayed or stopped until the lower punch has time to retract.

Limitations of punches and dies

Certain shapes require dies of weak design and must be modified to eliminate feather edges, very small pins or narrow die recesses. Furthermore, tools for briquetting narrow splines will necessarily be weak in design.

A little flat is required on taper parts in order to avoid a feather edge on the tool. On spherical bearings, a minimum flat of 3/32 in. on the OD increases tool life and makes for more economical production.

In general practice, a minimum wall thickness of 0.030 in. is recommended for punches to produce thin wall bearings or parts having thin wall sections. Any reduction in this wall area makes the tools susceptible to bending and buckling and very often presents serious manufacturing problems during heat treatment of the tools. Most presses have die cavities larger than is required for making high pressure powder metal parts. There are several reasons for this. The chief one is to provide ample thickness for the die cases when die inserts are to be made from more expensive die materials, such as high chrome-high carbon steels or carbide.

In checking die wall thickness, it is assumed for safety reasons that full transmission of hydraulic pressure is obtained, even though this is contrary to the no-side-flow theory previously indicated under Class III pieces. It is also assumed that the tensile stress in the die wall is distributed over an area corresponding to three times the thickness of the piece. No die wall failures have occurred using this rule-of-thumb method.

Materials for dies

Die inserts are sometimes held in place by shrink fits. The cases are then made of a chrome-nickel steel which is not as hard as the usual die steels, but is much tougher. This steel is also used when the die insert is to be held by screws, since this additional toughness minimizes thread failures. When making shrink fits, the usual interference between cold cases and steel inserts is about 0.0015 in. per in. of diameter. When carbide inserts are to be shrink-fitted, only about 0.001 in. per in. should be allowed, for the carbide will not "give" as much as the steel, because it has nearly three times the elastic modulus.

Regarding die (or die-insert) materials, the first test dies on any high production job are usually made of high carbon tool steel, which is comparatively inexpensive and easy to work. With these dies, shrinkage allowances and other operating details can be determined before proceeding with the production dies. These production dies are usually made of a more wear-resistant steel or (if total production justifies the expense) carbide inserts.

7. Parts with an internal flange are made by using a shouldered core rod instead of using shouldered die.

The useful life of a die depends on many factors, such as the nature of the material being pressed, the unit pressure to be used, allowable tolerances in the finished part, material of construction and surface finish in the cavity. High chrome-high carbon steels are used for medium production requirements. These steels produce from 5 to 20 times as many parts as the high carbon tool steels. The analysis usually runs about 12% chrome and 1.5% to 2% carbon and both oil-hardening and air-hardening grades are available. The air-hardening type is used for dies having sharp corner cavities which might not stand the shock of oil quenching. There are some very definite indications that new steels (in which much of the chromium is replaced by vanadium) will give much better die life.

Where volume of production is high (or tolerance requirements are close) dies should be made of carbide, and low cobalt percentages should be used. Dies for pressing carbide materials must be made of carbide; the best of die steels would produce only a few hundred thousand pieces before becoming badly worn.

Die design

Die entrance edges should be bevelled at a steep angle, about 30 deg. from the vertical. The bevel should be 1/64 or 1/32 in. deep, depending on the die size and the thickness of the pressed pieces. This bevel prevents injury to the punch faces when setting up and operating. Horizontal joints in or near the area of the die wall should be avoided, as fine powder works into such joints and spreads the sections vertically, in spite of all pre-

cautions regarding the finish of mating surfaces and high retaining pressures.

It is sometimes necessary to taper dies to relieve expansion strains during ejection, otherwise horizontal laminations may appear in the compressed pieces. It is usually unnecessary to make full allowance for the complete expansion of the pieces. An allowance of two thirds is usually sufficient. If the pressed piece after ejection is 0.006 in. larger than the die (at the compression point), the taper can be made 0.004 in.

Core rods in general have the same operating requirements as dies and should be made of the same material. Small rods should be made of tougher material and the design of core rod and holder should permit easy and inexpensive replacement of the working section of the core rod tip. Chromium plating (to bring the tips back to size) should be used only with the greatest caution and only when the required plate thickness is less than 0.001 in. Thicker plating may crack off and ruin a set of punches. During the last few years a process known as flame-plating (see Design Engineering, June 1956) has been developed by the Linde Air Products Company. This enables tool manufacturers to coat core rod tips with carbide.

Punch steel requirements are very different from die steel requirements. Here toughness is an important factor. High carbon-high chromium steels are too brittle in most instances. Punches of thick section or intricate shape should be made of steel with 3% nickel and ¾% chrome and carbon between 0.40 and 0.50 points. The lower carbon content is used when sections are thin or chamfer edges are present. Special analysis steels in the SAE 3400 class are used. For less delicate parts SAE 3200 steels are used. It is usually a simple matter to reface punches and a much less expensive operation than replacing broken ones. When abrasion of punch faces is high, punch inserts can be used. In some cases in multiple-punch set ups, a punch may have to function partly as a die, as shown in Fig. 9.

Carbide punch faces are sometimes used in pressing abrasive material. Although the limitation is currently being corrected, these faces have a tendency to pit at high pressures and also to separate from the steel after a number of pressings. Producers using carbide punch faces should be equipped for replacing and refacing the punch tips. The grade of carbide used on punch faces is not as brittle or as hard as that used on die-inserts. The 9% to 12% cobalt grades are more durable and are usually used for punch faces.

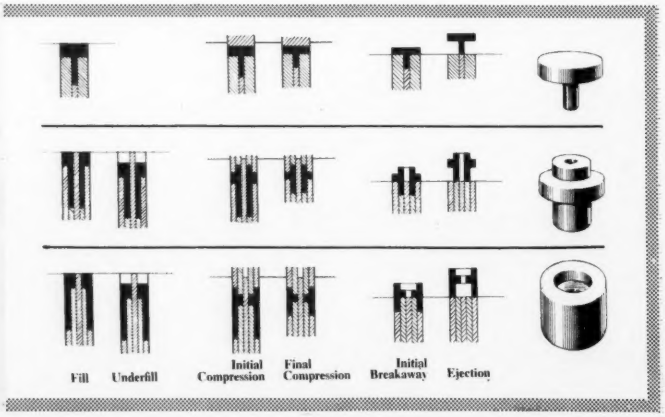
Lower punches should be "relieved" or ground undersize on the OD and larger on the ID to permit the escape of powder passing down between the punch faces. The "land" or full-size section should be narrow (⅛ in. to ⅜ in. usually) depending on the diameter and thickness of the compressed pieces. If a shouldered die or core rod is used, a corresponding "land" should be left longer on the punch to reach below the shoulder of the die at ejection. This maintains the normal close clearance and prevents powder from running through the relieved sections.

Punches should be made to fit the dies and not made to tolerances. The tolerance should be on the die and core rod dimensions. The finest fits are used. Any slight variation in powder fill tends to push the core rod to one side, taking up all the clearance in one direction and producing eccentric parts. No amount of pressure in the subsequent sizing operation can entirely correct the original eccentricity. For bushings, the diametral clearance is usually not over 0.0002 in. For other applications, the clearances are more liberal, 0.0005 to 0.001 in. on the diametral dimensions.

In the making of the punches themselves, concentricity of punch and the punch shank or punch holder need not be held to high accuracy. Most presses manufactured today include provision for a side-wise movement in the punch and die socket so that accurate concentricity can be obtained during set up. However, there is no provision for adjusting out-of-square and the squareness must be accurately maintained in these tools.

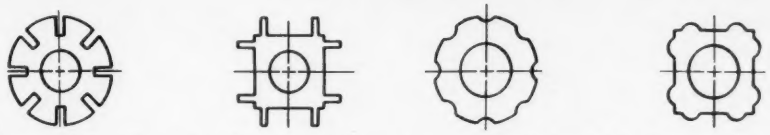
Die cavities and core rods should be lapped and polished to a high finish after final grinding, and the last polishing or lapping should be parallel to the axis of compression. The micro-inch finish should be 5 or better. When surface finish cannot be readily checked by profilometer, a visual check for "mirror" finish by an experienced tool maker is satisfactory.

Punch faces and punch lands should have the same surface finish as the die cavities, and the final polish on punch lands should be parallel to the punch axis.

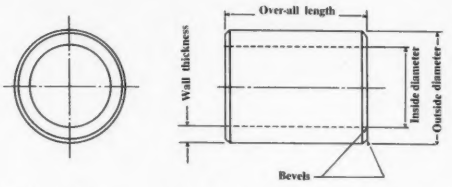


8 and 9. These parts have different pressing levels, such as step flanges or double hubs and as a result they will require use of additional punches or additional spring sections. Fig. 9 shows three parts in sequence.

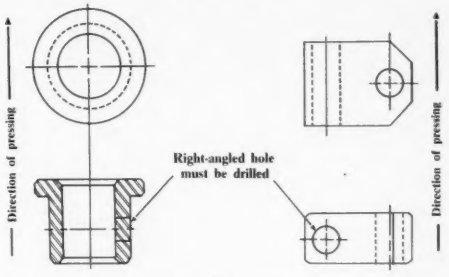
10. Typical design considerations.



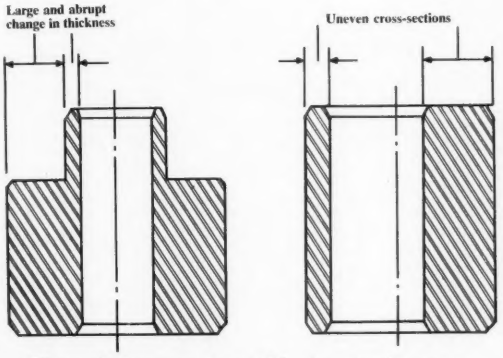
Avoid parts with very narrow and deep splines. Parts with splines likes those at right are best.



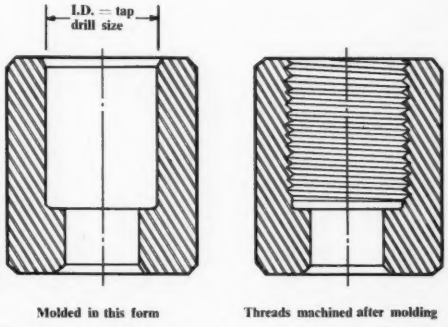
Good design properties for powder metallurgy.



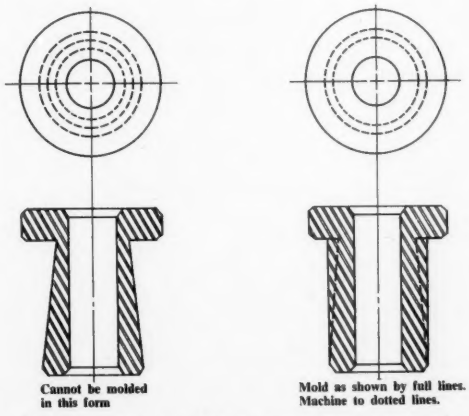
Holes at right angles to direction of pressing will not mold but will necessitate drilling.



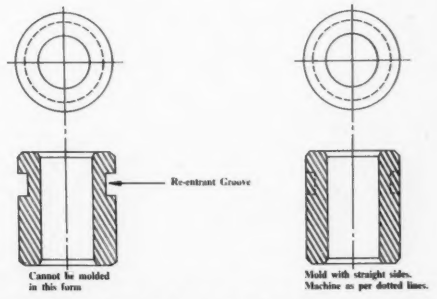
These designs are unsuitable for powder parts.



Both these designs are good for powder parts.



Design at left is bad. Design on right, good.



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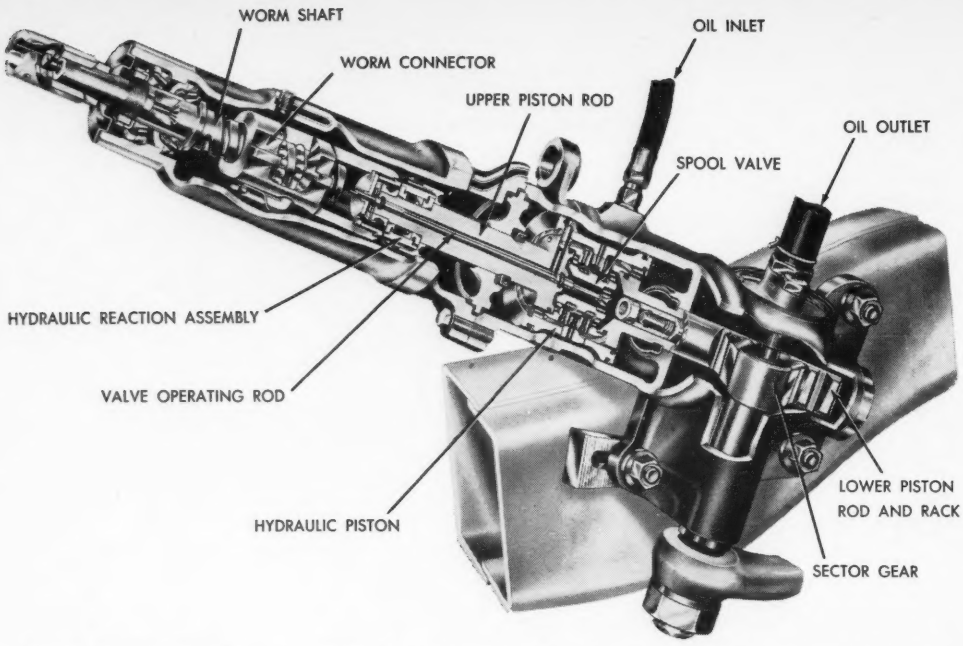


1. In the "full-time" Chrysler gear, 80% of the steering effort is taken by the power assist from the start.

Mechanical muscle makes steering easy

Power steering is rapidly becoming a necessity rather than a luxury

Until recently, the effort required to steer a car was not considered burdensome. Any help (which usually came from the rear seat) was purely supervisory. Yet now, something like a quarter of all the cars made in Canada and the U. S. are fitted with power-assisted steering.

One reason for this is that tires have become wider, have lower inflation pressures and thus have more surface to scrub on the road. Cars have grown heavier and both passengers and engines have been moved toward the front end, so that more than half the total weight is now on the front wheels. Older people are driving, more and more cars are on the road, and there is more manoeuvring into tight places.

All these changes mean that greater steering effort is required and, to help matters, engineers first made a number of detail improvements. Steering-gear ratios (turns of the steering wheel per turn of the road wheels in steering) were increased; ball bearings were used wherever possible. But a limit was reached and, five years ago, power-assisted steering (long used on buses, trucks and large military vehicles) was offered as an extra-cost fitting on one make of car. It is now available on every American-type car and is standard on two.

Whether it is worth having or not is a matter of preference. When you first try it, you will hardly notice any difference in open-road driving, but will be delighted by the ability to make sharp turns with one finger on the wheel. Power steering has advantages from the safety point of view, making it possible to steer out of trouble or to overcome the pull of a blown out front tire. Most drivers feel far less fatigued after a long journey with power steering, probably because it adds a hydraulic damper to the steering gear and thus tends to prevent road shocks from reaching the driver through the steering wheel. From the engineer's point of view, power makes it possible to go back to a lower steering ratio, so that less winding of the steering wheel is required, and to regain a free hand in working out the best steering geometry, that is, the exact setting of the kingpin (the more-or-less vertical pin, about which each front wheel swings in steering).

Now as to how it works. The power is obtained from oil supplied under pressure by a pump driven by the engine. As in all hydraulic power systems, the heart of the mechanism is a valve which controls the flow of the oil. In this case, the valve is moved from side to side, to uncover ports drilled in the valve housing when the driver turns the steering wheel. Oil flows through the ports to a double-acting power cylinder, the piston rod of which is connected to some convenient point in the steering linkage.

So far, power-assisted steering is very similar to the hydraulic control mechanisms found in many airplanes and power tools. But a most important difference is that the power system must be added to (and must in no way replace any part of) a complete mechanical steering gear. That is, it must "fail safe." The driver must have full control of his steering in spite of a complete failure

of the hydraulic gear. Also, as we shall see later, refinements have been added to restore the "feel of the road."

We need not consider the design of the oil pump in detail. Several makes of pump are available, capable of supplying oil at 1½ to 2 gpm at from 750 to 1,000 psi. In most cases, the pump is mounted on the end of the generator, which in turn is driven by a belt from the engine. The reservoir and filter are built right into the pump housing.

The heart of the system is the control valve; both poppet and spool valves are used, the spool type being far more general. Fig. 2 shows a complete Saginaw steering gear (less the linkage to the front wheels) in diagrammatic form. This gear is used on all General Motors cars. The spool valve is shown as though it were in a separate housing below the rest of the gear, but in actual practice the valve housing and the steering gear housing are in one casting and the oil passages are drilled. The other parts of the gear are familiar enough —the steering wheel, which, when turned, winds a nut (in the power gear this nut is also the hydraulic piston); the nut moves the steering arm, through a rack and pinion, to steer the front wheels.

The gear is shown in Fig. 2 as it would be with the steering wheel set to drive straight ahead. The control valve is centred and is held central by a spring, no hydraulic effort being exerted. Note, however, that the oil flow is not cut off, but that oil is free to enter both ends of the hydraulic cylinder equally. It builds up an "idle" pressure of from 30 to 50 psi and fills all the available space, keeping all air out of the system and forming a damper.

In Fig. 3 the steering wheel of the Saginaw gear has been turned so as to steer to the right. The piston has been wound (as a nut) to the right by the ball-bearing thread. The steering arm has been moved so as to swing the wheels over and steer the car to the right. So far, this has been a straight-forward mechanical job: How about now getting some power assistance?

To get the hydraulic system to help, we must first move the valve. Note that the ball-thrust bearing which locates the steering shaft lengthways has been pulled slightly to the left, in spite of the springs (not shown) that hold it central. This movement is just a few thousandths of an inch, but it is sufficient (working through a 2½ : 1 lever) to pull the spool valve off to the right. Oil pressure is now applied to the left end of the power cylinder and the return line shut off, while the return line is simultaneously connected to the right end of the power cylinder and pressure cut off. Thus hydraulic effort is added to help push the piston to the right.

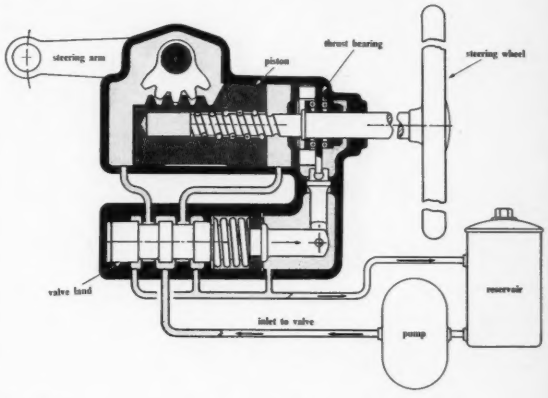
Just as soon as the required work has been accomplished (or just as soon as the driver stops pulling at the steering wheel), both the thrust bearing and the spool valve return to neutral, a balanced oil pressure is restored to both sides of the piston and the steering position is held.

In order to prevent the power helper from jumping in too eagerly and perhaps tending to take charge, the centring springs of the gear's thrust bearing and valve combine to hold the valve central until the driver has exerted at least 2 lb pull at the rim of the steering wheel. Up to this pull, steering is mechanical and unassisted: beyond this pull, power assistance comes in.

Chrysler engineers do not agree with this. In the "full-time" Chrysler gear (shown in Fig. 1), 80% of the steering effort is taken over by the power assistance right from the start. As this illustration shows, the gear is extremely compact. The spool valve is placed right inside the hydraulic piston and the whole mechanism fits neatly inside a steering column that is little larger than standard. The spool valve is pushed (or pulled) directly by the worm nut and is designed to be fully open at only 0.003 to 0.004 in. displacement. It is first hardened, then ground to a clearance only 0.0003 to 0.0008 in. (on diameter) in the valve housing.

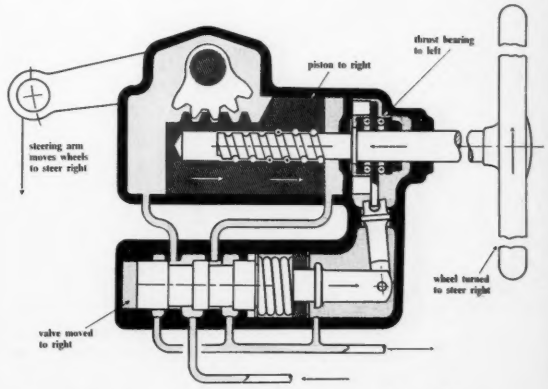
If you are a skilled driver, you are lost without the feel of the road (the resistance to your pull on the steering wheel) especially on a slippery road or when cornering at high speed. Accordingly, in both the Saginaw and the Chrysler gears, a feedback arrangement indicates to the driver how much help he is being given by the hydraulic system, by stiffening the resistance to further turning of the steering wheel as oil pressure builds up. In the Saginaw gear, however, this feedback pressure is limited to 250 psi by a relief valve, in order to limit the effort required to turn the steering wheel when parking.

In other designs of power-assisted steering gear (such as the Bendix (Ford cars) and the British Girling gear) the spool valve is almost unchanged, but the port arrangement in the valve housing is slightly different.



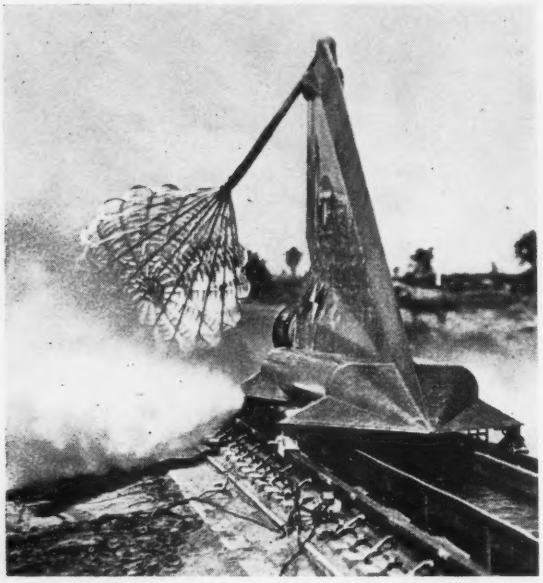
2. Gear shown with the steering straight ahead.

Here's the "inside story" on the mechanism

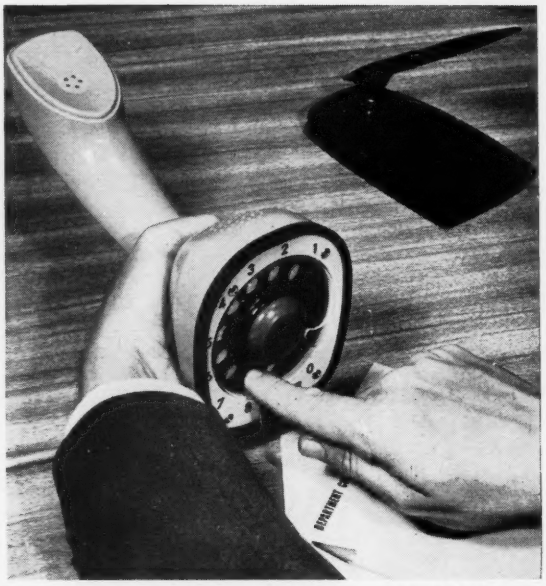


3. Saginaw gear is turned to steer to the right.

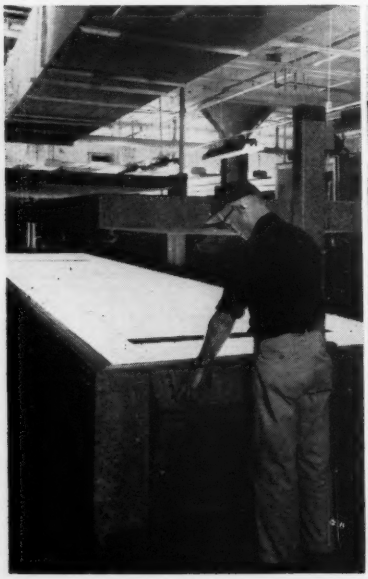
Design news in pictures



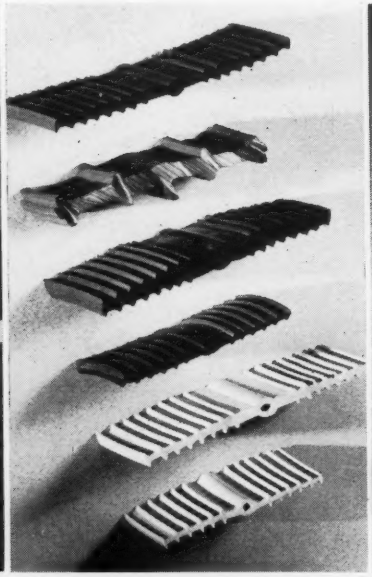
Undisputed holder of the "world's fastest railway" title is that at Edwards Air Force Base in the Mojave Desert. Two miles long, its sled (rocket powered) hustles up to 900 mph before a water trough between the tracks slows it again. The Cook sled is shown here as it begins to brake in the water trough during highspeed chute testing. (201)



A one-piece, lightweight telephone—the Ericofon—is now available in Canada. Designed by the L. M. Ericsson Telephone Company (of Stockholm, Sweden) it is probably the first really new design since the dial system was introduced. By doing away with all the unnecessary parts in a two-piece handset they improved what was left. (202)



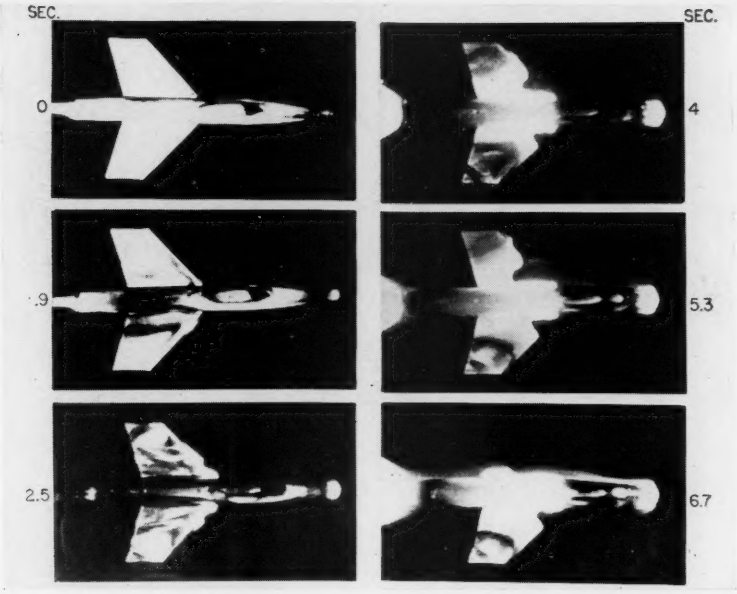
One of the largest solid granite surface plates in Canada has been set up at Orenda Engines Ltd. Measuring 12 x 6 x 2 ft. it weighs around 15 tons and will be used to check the test equipment on Iroquois jet plants. (203)



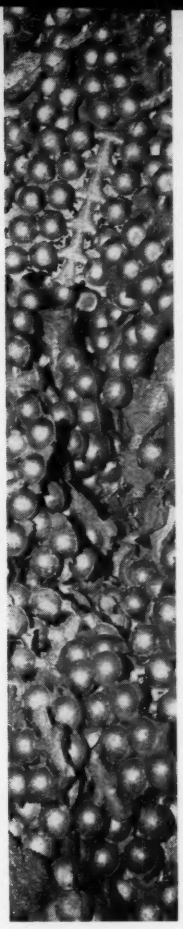
A new type of waterstop is in use on many construction projects. It is a Bakelite elastomeric vinyl compound produced by Electrovert Inc. and has the name Durajoint. A cross section photo shows variety of patterns. (204)

Canny German answer to the universal parking headache is this brainchild of Dusseldorf engineer Paul Schumann. The parking wheel will hold 51 cars in its compartments and requires only 21 x 75 ft. for its installation. (205)

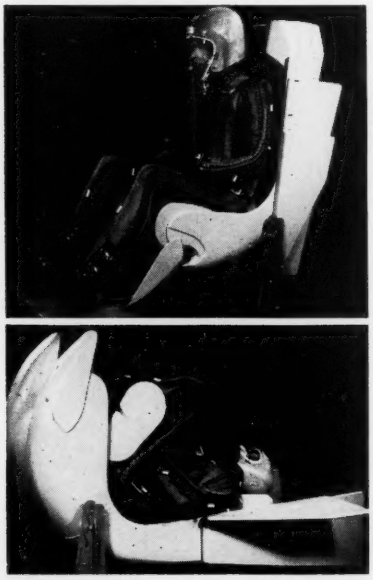
Some modern designs making news today



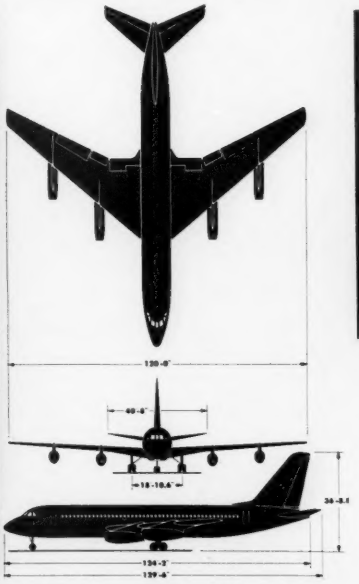
At speeds exceeding the speed of sound in the supersonic range, from Mach 1 to 5, and at hypersonic speeds above Mach 5, a new problem is superimposed upon all the other flight problems—that of aerodynamic heating. Dramatic warning of these problems is given in the six exposures shown above. Model plane of stainless steel simulates 4,500 mph flight at 50,000 ft. The miniature glows, starts to melt and then disintegrates within 6.7 seconds. (206)



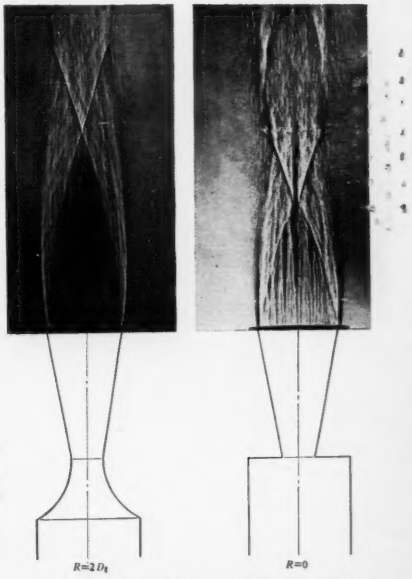
Bearing a startling resemblance to a cluster of frozen peas is this shot taken at the Wabi Iron Works in New Liskeard, Ontario. They are Ni-Hard nickel abrasion resisting iron grinding balls fresh from their molds before cleaning and inspection. (207)



All set for a ride in a supersonic ejection seat the pilot (top photo) is in normal flight attitude. Aerial bobsled rotates 90°, grasps pilot, sprouts wings and (rocket powered) is ejected into the airstream. (208)

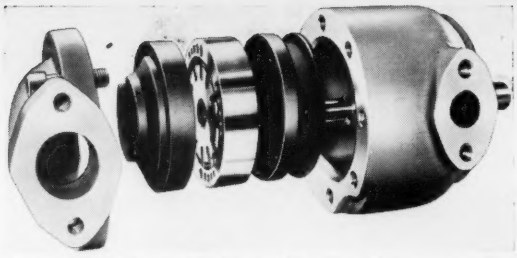


A three-view drawing of the Convair 880 jet airliner which, according to Convair, is the fastest commercial airliner in the world. The 80-passenger plane is of medium range and will be produced in San Diego. (209)



Catching the Editor's eye recently was this illustration from a British journal called The Chartered Mechanical Engineer. It illustrates by shadow photographs air discharging from different radii nozzles. (210)

New Pump has hydraulic vanes



An exploded view showing main parts of the vane pump.

This pump operates with equal efficiency clockwise or anti-clockwise

A new series of balanced vane hydraulic pumps for continuous 2,000 psi service has been announced by the Denison Engineering Division, American Brake Shoe Company.

Known as the T series, the pumps feature a hydraulically balanced vane, the key to the continuous high efficiency of the pump. They supply rated deliveries of up to 100 gpm at speeds up to 1,800 rpm.

The pump consists of a housing which provides an outlet connection, a bore for support of the shaft bearing and shaft assembly and a larger bore which contains the floating pumping cartridge. This consists of a front port plate, vane, rotor and cam ring assembly and rear port plate, with a shaft end support bearing. By providing maximum shaft support, the bearings permit use in applications with higher shaft side loading.

The port plates are part of the pumping cartridge. Since they are not a part of the pump housing, the inlet port plate and pressure discharge port plate are made from material selected to give maximum resistance to wear. However, should it be necessary to replace these plates, it can be done easily by removing the end cap, and sliding the cartridge out. To provide the required clamping force on the pumping cartridge, the pressure loaded port plate is designed so that the clamping force is always slightly greater than the deflecting force.

Two-bolt threaded flanges are provided as standard equipment but four-bolt hydraulic connections are available for those desiring to use S.A.E. four bolt split flange connectors. A nose type shaft seal, designed to withstand inlet pressures up to 100 psi gage, provides a positive type seal with considerably longer life.

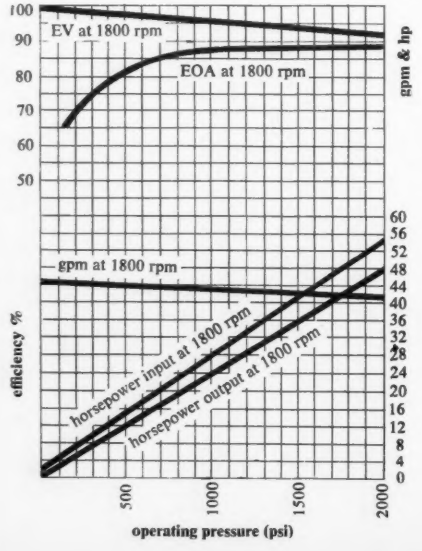
The pump may be face, foot or flange-mounted in any of the four positions on its mounting bracket. The suction inlet port can be assembled in many selected positions with regard to the pressure delivery port.

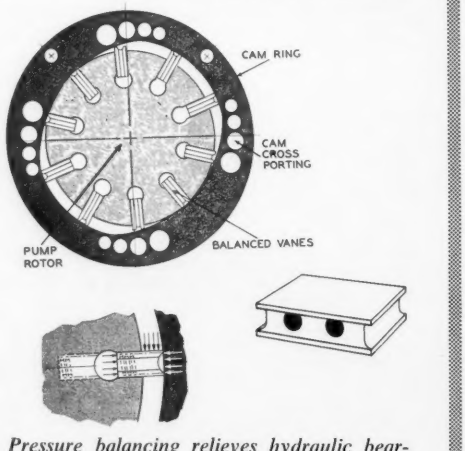
The balanced vane is achieved by a construction allowing the vane to be open at both ends to pressure on the pressure stroke, and suction on the suction stroke.

Pumps of this series are particularly suitable for earth-moving equipment, trucks, buses, tractors and power shovels, where 2,000 psi hydraulic pumps mean lower weight and increased payload; for special machinery such as an extrusion press, where 2,000 psi pumps require less space to pack more power and provide greater operating efficiency; for automation where these 2,000 psi pumps mean increased operating efficiency, simpler design, lower maintenance for feed circuits and index mechanism.

Simple to service — replaceable port plates and pumping elements can be easily serviced. ★

Performance curve of a 2,000 psi vane type pump shows its high volumetric efficiency.

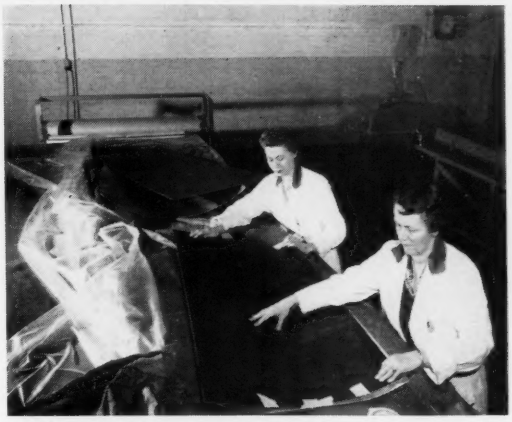




Pressure balancing relieves hydraulic bearing loads between vanes and cam ring (lower left). Hydraulically balanced vane uses the internal oil pressure for sealing at edges.

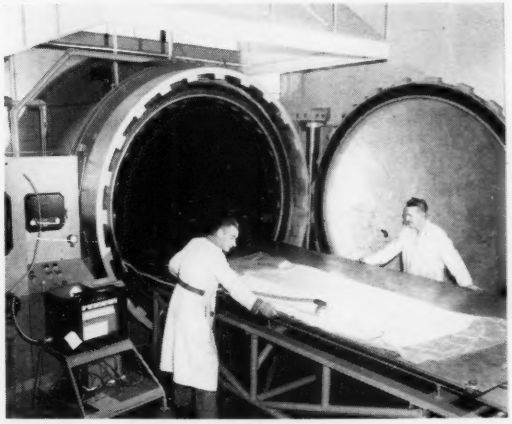
Autoclave forming of magnesium skins

Bearing in mind that magnesium needs heat and pressure in skin forming, this company used its autoclave with some excellent results



1. The magnesium is taped to an aluminum master then felt-wrapped in polyvinyl bag with vacuum attachment.

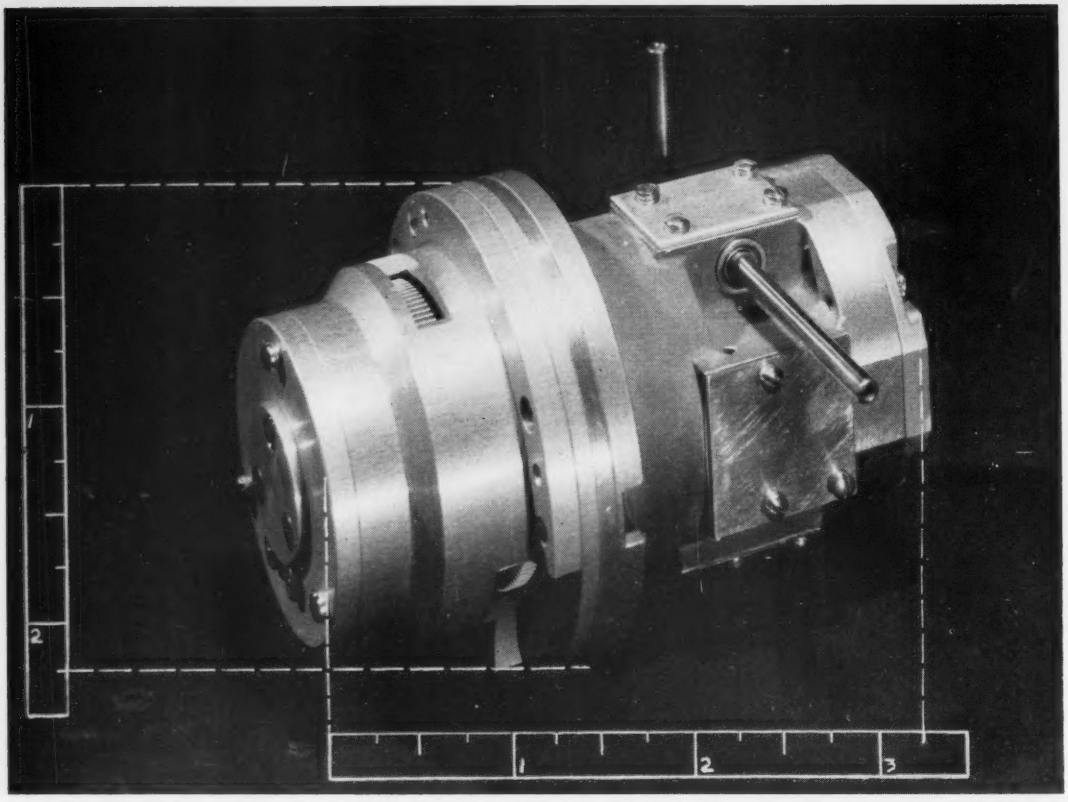
2. A connection to vacuum pump exhausts polyvinyl bag causing magnesium to hold shape of aluminum master.



3. With thermocouple and vacuum attachments in position the bag and contents are placed in the autoclave.

4. After cooking under pressure the job is taken out and polyvinyl bag (now brittle) and felt are removed.

5. A successful bake with the sheet of magnesium on left now shaped to the contours of aluminum master.



1. This ball resolver, made by Aviation Electric Limited, is pictured here slightly larger than actual size.

Old idea sparks a tiny new calculator

Miniature resolvers may find their big future in the missile field

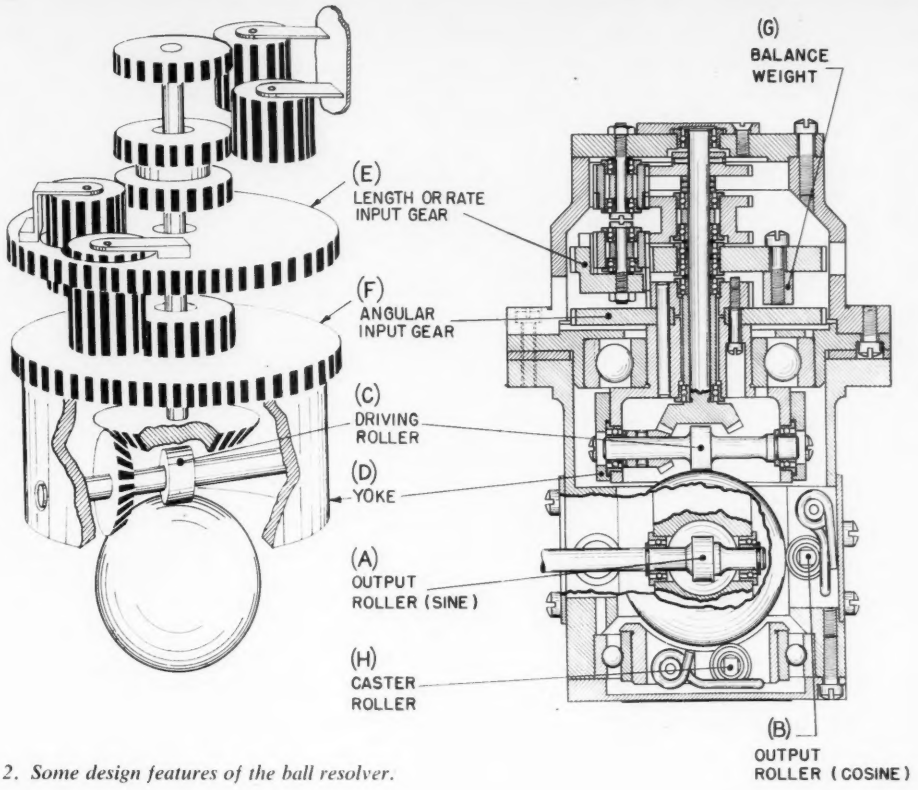
A 19th century principle with a 20th century application

In this age of automation we are getting accustomed to daily meetings with strange, new names for machinery and components. The Ball Resolver may appear to fall into this category, until we start to investigate its underlying principles of operation. Basically, it is a mechanical calculator that can evaluate two input values in terms of trigonometrical (or other) ratios.

As though to bear out the old adage that there is nothing new under the sun, we find that, as far back as 1878, a Senor Ventosa of Madrid was credited with the invention of a device for the continuous calculation of wind component forces. His system of a sphere and four rollers was almost identical with that used in modern ball resolvers.

In 1884 Professor H. S. Shaw (of the British Royal Society) presented a paper on the theory of continuous calculating machines that went deeply into the governing mathematics of these devices. At the same time, he introduced a ball resolver of his own design. Although this did not possess the same degree of mechanical exactitude as our present-day models, it was nevertheless similar.

Miniature resolvers can look forward to a bright future as research and development into guided missiles and space satellites presses forward. Although (as they become smaller) their power output decreases considerably, amplification through servo systems is readily applied. Servo amplifiers in lightweight form (using transistors and miniature components) can more than compensate for such decreases in power.



2. Some design features of the ball resolver.

By F. W. Taggart and L. S. Eggleton

AVIATION ELECTRIC LTD.

The goal of designers has always been to obtain as frictionless a device as possible and it is generally agreed that surfaces rolling upon each other offer the best chance of doing this.

Professor Shaw's ball resolver was probably the first of its kind to use the same methods as today's models. For present day applications, however, it would be relatively large and inaccurate. The earlier models, in fact, used a wooden ball and it was suggested that the surfaces of the rollers be serrated to give a better grip!

Mankind, stimulated by war (or the threat of war) has come far since then. Certainly the need for accurate gunnery control led to much of the development work carried out on mechanical computers.

The basic principle of operation of a ball resolver is explained in Table 1.

A miniaturized ball resolver working on this principle was recently developed by Aviation Electric Ltd. It is being used as a component of automatic navigational equipment, where it takes part in the integration of speed and direction into a continuous indication of position, in terms of the N-S and E-W components of the journey. Where this takes place over a small area, it is almost equivalent to a record of the change in latitude and longitude. In addition to these mathematical properties, the smallness and lightness of the resolver make it particularly suitable for guided missile controls under the severest conditions. In practice, it accepts inputs in terms of shaft speed and angular change, and in return gives outputs in terms of trigonometrical ratios of the input angle. In both gunnery and navigational problems, the situation frequently arises where a continually changing angular rate has to be integrated with a changing range or distance rate. This ball resolver expresses these in terms of sine and cosine functions, in the manner explained in Table 1.

Gunnery and navigation

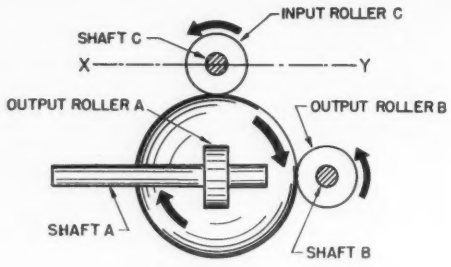
To have a resolver giving a continuous calculation of sine and cosine ratios is a valuable asset where gunnery control (or navigational problems) have to be solved. Trigonometrical ratios are, of course, easily computed under normal conditions, where fixed values and time to make the calculation are available. It is the necessity for making instantaneous and continuous calculations (whilst the two hitherto fixed values are varying widely) that defeats the human operator.

It may appear from Table 1 that the modern ball resolver is a remarkably simple device with which to achieve such far-reaching results, but behind the simplicity of principle are hidden the hard-won solutions to many design problems.

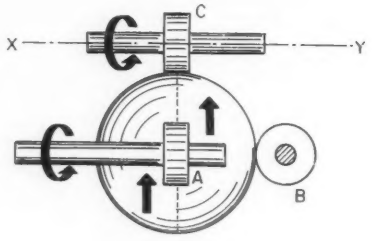
We do not know at what standards of accuracy Professor Shaw was aiming when he developed his early ball resolver in 1884, but the wooden ball used in it would certainly be useless under today's conditions,

TABLE 1

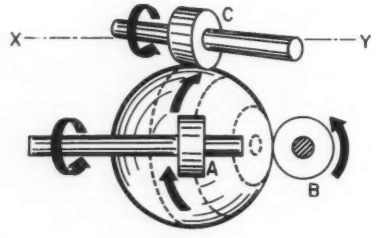
Basic principle of operation of a ball resolver



Input roller (C) is being rotated and turns the ball as indicated by the arrows. If we take this position as 0 deg (where shaft (B) is at right angles to shaft (A)) rollers (B) and (C) will rotate at the same speed. Shaft (A) will not move, because the ball is merely pivoting on the surface of roller (A).



Here we have the condition where the axis of shaft (C) has been moved 90 deg from its previous position so that it is now parallel to shaft (A). The angular input is now 90 deg.



Shows an intermediate position, where the axis of shaft (C) has been changed by 60 deg. By tilting the driving shaft in this manner we have caused the ball to rotate on a different axis and have, in effect, changed the positions of the two rollers (A) and (B). The diameter of the two circles at the points of contact has now increased with respect to one roller and decreased with respect to the other. In this particular case,
speed of (A)
= speed of (C) x sin 60 = 0.866 x speed of (C)
speed of (B)
= speed of (C) x cos 60 = 0.500 x speed of (C).

Ball resolver *continued*

where an accuracy greater than 0.3% is demanded.

To provide a ball resolver suitable for accurate work in aircraft or missiles, the design engineer had to consider the severe conditions under which it would operate. The temperature range to be encountered would be between +160F and —65F.

The effects of acceleration would be felt in all directions and would range up and beyond the limits of human endurance. Under these conditions, the over-all error must not exceed 0.3%.

There is not sufficient space here to consider fully all the design problems that were met. A few examples will perhaps show what considerations were necessary to attain sufficient accuracy to satisfy today's exacting standards. Compromise is probably the uppermost concept in the designer's mind.

Let us examine the basic matter of selecting the most suitable size for the ball resolver. The following thinking governed the final choice of a 1-in.-diam ball.

In favor of a large ball (2 in. diam). A larger area of contact between ball and roller resulting in:

1. Less wear due to slipping and work loss under load.
2. Surface loading at point of contact is spread over a wider area, so there is less chance of damage to the surface.
3. Cost saving, since less accuracy is needed in manufacture. (For example, grinding of the roller faces and thus cheaper machining).

Against a 2-in. ball. Weight is eight times that of a 1-in. ball. The increased weight would lead to:

1. A greatly increased effect.
2. Heavier springs, needed to keep the rollers in contact against g forces, would lead to increased wear on the ball and roller surfaces.

In favor of a smaller ball (½ in. diam). Less weight is always a favorable factor in aircraft components. In addition, it has advantages such as:

1. Greatly reduced g effect.
2. Lighter loading spring, and therefore less wear.

"Behind the simplicity of principle hide some hard-won solutions"

Against a smaller ball:

1. Need for highly accurate machining keeps cost high.
2. High surface loading due to a small point of contact.

Another interesting factor considered was the inherent slip between two spheres (or a sphere and roller) in rolling contact with each other. Even the hard steel of the ball and roller is not incompressible and, like two rubber balls pressed together, becomes flattened at the point of contact. The ball resumes its normal diameter after passing the contact area, but in doing so causes the speed of rotation to vary slightly.

Strangely enough, this effect also has its compensations, for if it did not exist (and the contact point were indeed infinitely small) the surface loading would be infinitely great and the ball would in theory disintegrate. In actual fact, the flattened area is sufficient to distribute the load, although startlingly high loading values can still occur for loading-spring tensions of only a few pounds.

Ball rolling on flat surface

Such an insignificant item, even, as a particle of dirt can produce errors apparently quite out of proportion to its size. If we consider the case of a ball rolling on a flat surface and meeting a circular obstacle in its path, the following situation arises.

Let R be the radius of the ball and H the vertical height of the obstacle at the point of contact. Let F be the vertical force applied to the ball and call F_H the horizontal reaction produced by the obstacle. Then,

$$F_H = F\ \sqrt{2H/R}$$

The size of the obstacle is:

$$H = R/2\ (F_H/F)^2$$

If we have a 1-in.-diam ball, and assume that we can only tolerate an error force of 3 oz. and that the spring exerts a vertical force of 12 lb on the ball, the size of a tolerable obstacle is only:

$$H = \frac{0.5}{2}\left(\frac{3}{12 \times 16}\right)^2 = 6.1 \times 10^{-5}\ \text{in.}$$

A rather startling conclusion that a minute object of 0.000061 in. diameter can cause a reaction of 3 oz!

In the case of a ball resolver with two curved surfaces in contact, however, we find a marked improvement. Here, only that portion of the obstacle between the ball and the tangent to the point of contact is involved in the reaction. It is inversely proportional to the ratio of the diameters of the ball and roller.

Let us assume a 1-in.-diameter ball and a ¼-in.-diameter roller (a ratio of 4:1). The portion of the obstacle between the ball and the tangent is now 1/5 of its previous value. Thus, to produce the same reaction of 3 oz, we can tolerate an obstacle of 0.0003 in. diameter, which, as the size of the tolerable dirt particle is related to the ball diameter, gives us another factor to be considered in the selection of ball and roller sizes.

Figure 2 shows some of the interesting design features of this ball resolver that have contributed, in no small measure, to its combination of lightness and accuracy. At E we have the first part of a differential gear train into which we can couple an input factor in terms of shaft speed, whilst at F the angular element can be introduced.

The differential method of coupling these inputs together was designed to allow continuous variation of the two factors without mutual interaction. The differential gear train operates somewhat after the manner of an automobile differential with one wheel stationary.

By careful design it was possible to insinuate this aggregation of gears into a remarkably small space in the upper part of the resolver case. A weight (G) keeps the input gear (E) balanced.

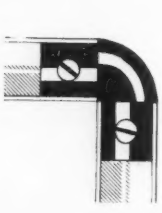
The yoke (D) carries the angular input gear, provides a stable mounting for the roller (C) driving the ball, and meshes the bevel gear on the driving roller with that on the differential. The gear ratio at this point (together with that of the differential), gives a 1:4 speed change, so that the outputs are actually four times the sine and cosine of the input angle. This feature was incorporated as a requirement of the original design, and is not an inherent feature. By changing the size of the gears, multiplication by other factors can be obtained.

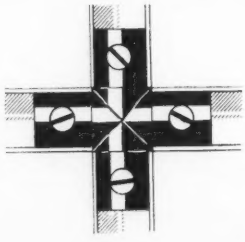
The rollers at (A) and (B), giving respectively the sine and cosine outputs, make contact with the ball surface which is held in place by spring-loaded rollers. The bottom roller (H) keeps the ball in contact with the driving roller (C). The same type of spring applies the pressure, but notice that the roller at (H) is not central but is offset slightly. Here we were able to introduce a happy combination of less wear with reduced cost. If the bottom roller (H) were to be mounted centrally in fixed alignment with roller (C), there is only one point where grinding action will not take place. If the vertical axis of the ball passes through the exact centre of the area of contact (and the axis of roller H is exactly parallel to the axis of C) the two surfaces will roll on each other without abrasion. The factors affecting the exact location of this point are highly diversified, and would call for inordinately rigid standards in the machining of all parts, with greater skill needed at assembly. Fortunately, such expensive precision was avoided. By having the roller arranged to behave like a caster on a piece of furniture, we manage to get a rolling action with less wear. The location of the caster shown in Figure 2 is not its normal operational position, but serves to show the offset position and loading spring to better advantage. In service it will turn through 90 deg on the large ball race at the bottom of the resolver and finally align its axis with the axes of rollers (C) and (A). These, and many other factors, resulted in great compactness, for no space is wasted inside the case. But, anticipating tomorrow's exacting standards, even as we write, experiments are under way to improve performance. ★

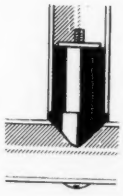
Ideas round-up

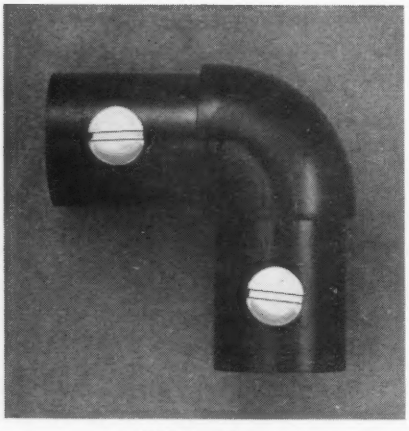
Award-winning design for fast tube fastening

Details are shown of a fastener which was awarded the Canadian Plastic Achievement Award in 1956 (Industrial Section). Its application is unlimited and it can be produced in any color in order to blend with the color of the tubing to be joined. Known as the Tu-Bit **(Die Plast Ltd.),** it can be fastened quickly, without the use of skilled labor; what is more, it can be very easily taken apart if desired. (211)

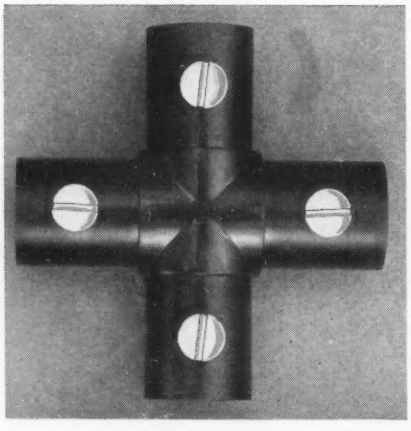




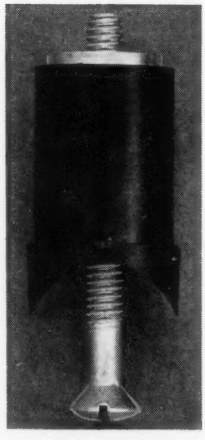




"L" junction



"X" junction



"T" junction

Brazing the pigtail for a chain burner

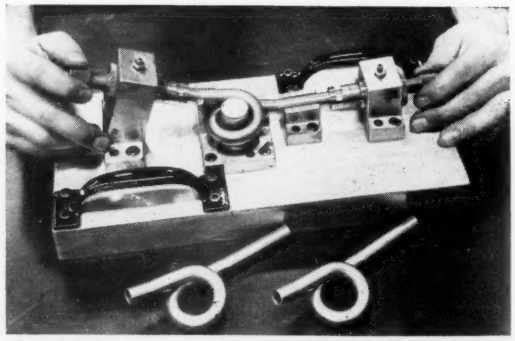
In the production of fuel manifolds for the chain burner of the Pratt & Whitney J-57 engine, **National-U. S. Radiator Co.** jig-brazes 755 separate pieces, using 380 brazes, into an assembly of 37-in. diameter.

Despite the size of the piece and the difficulty of brazing, a tolerance of 0.015 in. is maintained on the diameter of the manifold.

This is possible only because of the meticulous control of the brazing operation and of the components (and the materials from which they are made).

Tubing for the pig-tails is 0.3125 in. OD seamless inconel tubing (supplied by Superior Tube Company).

Tubing for the ferrules is type 347 (a columbium-bearing modification of type 304 stainless steel) which prevents carbide precipitation and resultant intergranular corrosion when the inconel pig-tails are copper



Checking the Inconel tubing for contour and diameter.

brazed to the ferrules before assembly in the manifold. It is supplied in the soft annealed condition in four sizes 0.3825, 0.436, 0.561 and 0.623 in. OD to AMS 5646.

The inconel tubing is bent into a pig-tail to absorb vibration and prevent fracture. It is cut into 12-in. lengths. ($\pm$0.020 in. on the length) and is then bent to the pig-tail configuration. The bent tubes are inspected for both contour and diameter in a fixture developed from a master tube.

The pig-tails are checked for length, contour, nicks, burrs, dirt and scratches. Each tube is also swaged. After inspection they are degreased and stored. (212)

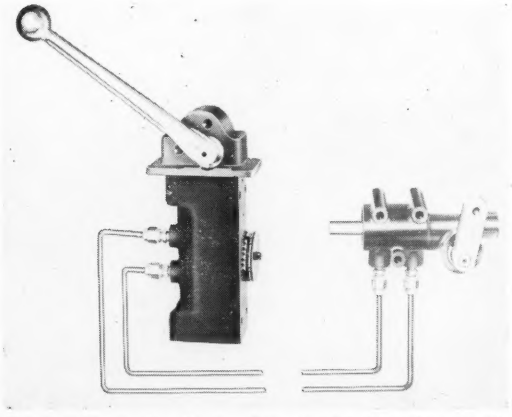
Compact remote control with a sensitive "feel"

A unit that provides designers and engineers with a positive, simplified remote control for positioning, controlling and duplicating movement at a distance is the Hydronic positive remote control. Return of the activating lever to a neutral position for synchronizing the two units is not necessary. This is accomplished by the same design features that provide for positive and equal hydraulic delivery of 500 in.-lb of torque, in both directions.

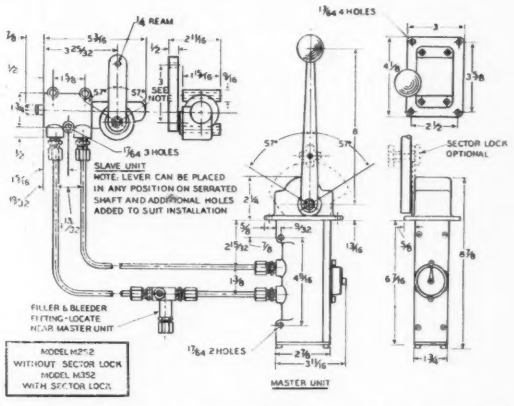
The control operates with a rigid, smooth stroke, absolute silence and sensitive "feel," performing the common control functions of bell cranks, rods, cable, gear, racks, sprockets and chains. Backlash, wear, lubrication, service, replacement stocks and other problems associated with the use of mechanical devices are eliminated. This control has the added advantage of compactness. It can be installed generally in less space, more easily and at less cost than most mechanical controls.

The unit is engineered for positive remote operations of controls, clutches, transmissions, valves, throttles, equalizers and governors.

A few representative applications are: processing machinery, earth moving equipment, aircraft, marine power craft, farm machinery, railroad equipment, power plants, assembly fixtures, construction equipment, military vehicles, test cells, machine tools and presses. (213)



Compactness of unit can be seen in this photograph.



Sector lock for the remote control unit is optional.

This new brazing alloy can be painted on

A self-fluxing brazing alloy (Alumibraze) for joining many types of aluminum alloys is now being offered by **Handy & Harman.** Supplied in dry powder form and applied as an aqueous slurry, it is designed for use in a molten salt bath. It will join the following aluminum alloys: 2S, 3S, 52S, 54S, 61S, 62S, 63S, 66S and several types of casting alloy.

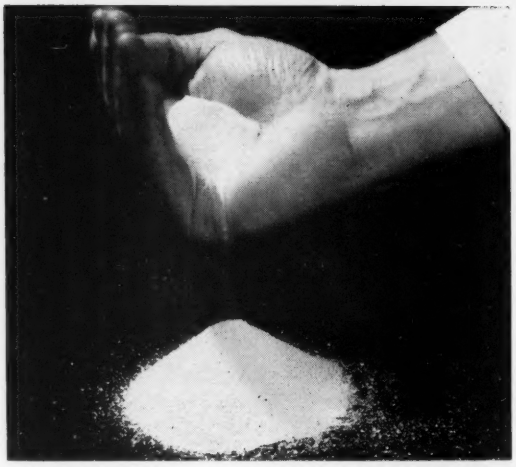
The alloy offers a number of advantages for production brazing of aluminum and makes possible certain joining techniques formerly not practical. The alloy is "painted" on, and so can be applied to any surface, regardless of its contour. It can therefore be used to braze assemblies where the shape of the parts (or the location of the joint) makes it impractical to use preforms or impossible to handfeed solid brazing alloys. The alloy stays put, will not flow prematurely and wets only those surfaces to which it is applied. It is economical to use since, unlike clad-braze sheet, the alloy is placed only where the joint is desired. It provides a convenient (if not the only) way of repairing joints, since in many cases it is impossible to preplace rings or shims accurately on already-brazed assemblies.

The brazing alloy contains its own fluxing material which serves both as a flux and as a cement to keep the alloy in place during the brazing cycle. The characteristics of the flux are the key to successful joining. When the slurry is dried after application, the flux forms a cement which does not melt at the usual brazing

temperatures, but which is soluble in the salt. Thus, during brazing, the alloy becomes molten, but is held in place until the cement is dissolved. Dissolution of the cement allows the brazing alloy to fill the joint area by capillary flow, producing a strong, ductile and (if enough alloy is used) filleted joint.

The alloy is an aluminum-silicon eutectic (88% aluminum, 12% silicon), which carries the AWS designation BA1Si-4. It melts in the narrow range of 1070-1080F and is generally brazed at a temperature of 1100F. The strength, soundness and corrosion resistance of joints made with this alloy are at least equal to those made with a solid brazing alloy of the same composition.

The brazing is done in a standard aluminum-brazing bath. The flux-cement is completely compatible with the salt bath and becomes a useful part of the bath. Hence, the periodic analysis and adjustments are no different from those required with standard salt baths. (214)



A handful of the new aluminum brazing alloy powder.

Indium and tin alloy for sealing high vacuum equipment

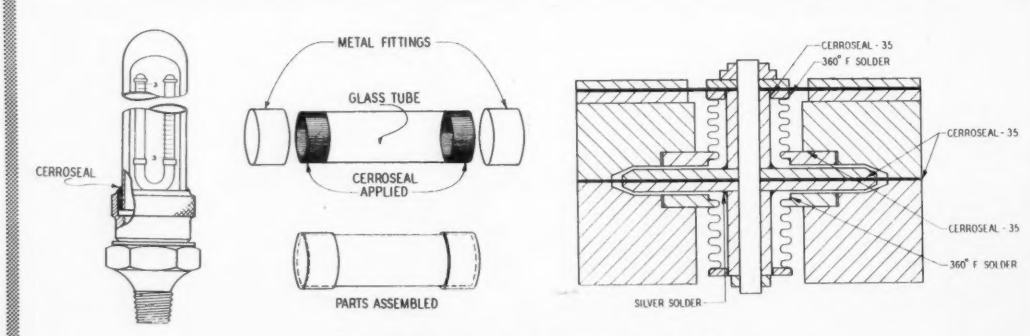
Because of its extremely low vapor pressure Cerroseal-35 **(Cerro de Pasco Corp.)** can be used in high vacuum apparatus requiring a seal between glass and glass (or glass and metal). It is an alloy of indium and tin which softens at approximately 240F and is liquid above 260F.

Besides adhering to glass, it will also adhere to mica, quartz, thermo-setting plastics and some glazed ceramics. Being rich in tin, it will bond to any metal that can be tinned with ordinary lead-tin solder, provided tinning is done at the same temperature (450F to 500F) as is required for ordinary solders with flux.

Since its introduction it has been used by a rapidly growing list of firms for regular production items. For example, one instrument maker replaces litharge and glycerine with Cerroseal-35 in sealing the glass dome to the metal base of a differential pressure gauge. Metal fittings are attached to each end of a glass cylinder by a maker of communication equipment; glass and quartz windows are sealed in peep holes of processing tanks made by two firms. Another employs it to solder electrical conductors to glass because it opens up new methods of constructing specialized apparatus.

Another instrument maker uses it as a metal-to-metal solder in assembling a special distillation control instrument. It is necessary during assembly to make several solder joints and insure that they are not melted in subsequent operations. The unit is constructed of brass and phosphor bronze. The original welds are started with eutectic silver solder and the final joint made with Cerroseal-35. This alloy has the advantage that there is no danger (during final assembly) of overheating the phosphor bronze diaphragms.

The material is used for the final sealing of some loaded components where a higher temperature solder would be too dangerous to use. (215)



Three applications of the indium and tin alloy

Continued on page 72

HERE'S PROOF THAT

this standard motor keeps dirt OUT

400-HOUR-TEST IN CLOUD OF TACONITE DEMONSTRATES EFFICIENCY OF SEALS

ALLIS-CHALMERS TOTALLY-ENCLOSED FAN COOLED MOTORS

SPECIAL MOTORS for dusty and dirty areas are now unnecessary. The highly efficient sealing method used by Allis-Chalmers on their standard totally-enclosed fan-cooled motor has been proved completely effective both in the laboratory and on the job.

For testing, a stock motor was put in a sealed box containing taconite as fine as 10 microns. The motor fan itself and an occasional burst of compressed air kept the dust circulating while the motor was running. After 400 hours the motor was disassembled. Careful examination showed no taconite dust in the stator windings or rotor; no dust inside the bearing housings on either end; no dust in the bearing chamber or inside the labyrinth seal.

JOB-TESTED, PROVED

Many operators have already used Allis-Chalmers rib-type TEFC motors in dirty and dusty locations. In every one of the applications, the standard motor proved that its seal was effective against grime.

As a new machinery component or as a replacement, it pays to specify an Allis-Chalmers motor. For further information, contact your nearest CA-C Sales Office, or write direct to Canadian Allis-Chalmers Ltd., St. Thomas, Ontario.

MADE IN CANADA

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57-M-1

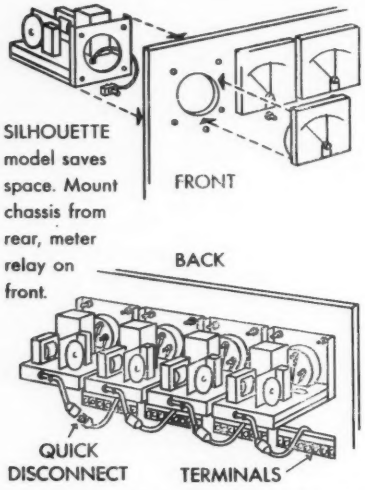
Two new chassis styles for original equipment

Two new and smaller chassis styles, especially designed for use in original equipment, have been developed for the Simplytrol and Versatrol "package" controls made by **Assembly Products, Inc.**

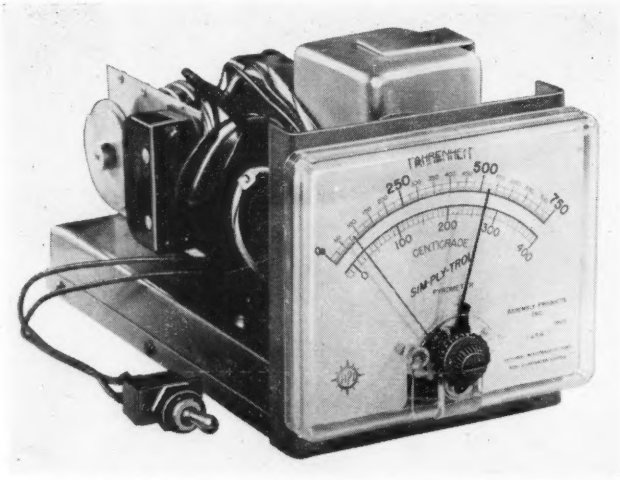
One of them (the Silhouette), is furnished without side or top panels. Most components are individually dust-covered, however. Available with all standard control circuits and components, the new chassis styles are intended for built-in flush-mounted applications where space saving is an important consideration.

Contact meter-relays used in these controls are 4½-in.-wide models, in either clear plastic or black bakelite plastic with glass windows. Chassis are 4½ in. wide and 7⅜ in. deep.

Switches for the Silhouette are mounted through the panel in which the unit is placed. (216)



Space-saving features of the Silhouette.



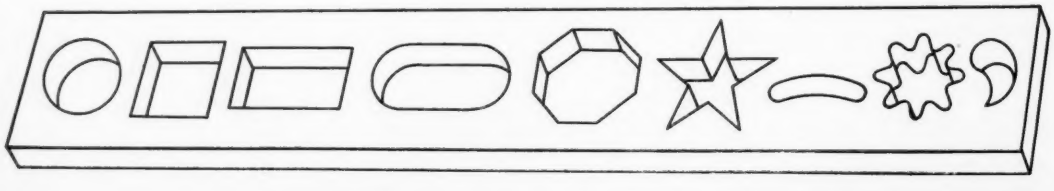
Switches for the Silhouette are mounted through the unit's panel.

Machine that will drill any electro-conductive material

Machining operations on carbide (and other tough materials that cannot be machined by conventional methods) is achieved by **Ex-Cell-O's** application of the Method X process to its new 243-6 vertical electrospark machine. This machine will pierce, drill, trepan, tap or sink a cavity in any material that is an electrical conductor. Its prime function is to machine hard metals or form special shapes that would otherwise be difficult to produce.

Applying the electrospark principle of machining to a mechanical unit, the machine is capable of positioning and holding the work, and feeding the tool to perform the desired operation. The table is mounted on slides so that the work can be positioned under the tool. Because the cutting action of the Method X process creates no tool pressure on the part being machined, only sufficient clamping pressure is required to make a good electrical contact.

The Method X machine accomplishes metal removal by the use of a positive electrode (or workpiece) and a negative electrode (or tool) energized by a high amperage electrical current. In this electro-mechanical process, electrical impulses pass between the tool and work, which are submerged in a dielectric bath. When the



Continued on page 76

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Lure shown above is a Gibbs Toronto Wobbler.

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tool and work are brought close together, controlled impulses remove particles of the work to form an inverse image of the tool. At no time does the tool actually touch the work. The particles acted on are ejected and washed away by the circulating fluid, leaving tiny crater-like depressions in the work, a characteristic of electro-spark machining. The cycle is repeated many times per second, with each successive electrical discharge producing a crater, until these blend into a nearly-smooth finished form. The resulting surface possesses a uniform matte-type finish.

In addition to machining hard materials (such as carbides), the machine will cut a variety of regular and irregular shapes. Samples of the irregular shapes possible are illustrated.

Tools used for the Method X process can be made from low-cost sheet brass, tubing or rod, depending on the operation to be performed or the shape required. Steel or other conductors may also be used for tool material. (217)

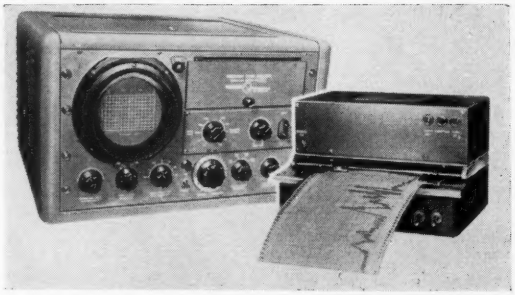
Sonic analyzer identifies electrical and mechanical defects

As a result of the spectrum analysis of sounds, vibrations and electrical waveforms, laboratory and production operations have been speeded up, engineering projects completed quicker and costs lowered in many industries.

An improved model of the LP-1 sonic analyzer developed by **Panoramic Radio Products, Inc.** provides a logarithmic sweep range of 40 to 20,000 cps and extends the linear sweep ranges of the LP-1 by 200, 1,000 and 5,000 cps. A companion recorder has also been made available to work with the LP-1a for charting purposes.

The instrument is being used to identify mechanical and electrical defects and variations, to make fine adjustments, to test production models against standards, and to improve product design of ball bearings, jet and reciprocating engines, electric motors, home appliances, business machines, pumps, blowers and fans, compressors, air frames, tire performance and many other types of rotating and oscillating machinery.

The instant visual picture of waveform content over a wide range makes it easy to check the frequency position and amplitude of any component or to compare and analyze data. In other words, by converting any parameter to an electrical waveform (through a sensing device such as a microphone), it is possible to determine the relative strength of the various components, to measure individual distortion components (rather than total distortion alone) and to observe changes in energy distribution as the waveform itself varies or as design constants are altered. Thus the LP-1a eliminates tedious, complicated, point-by-point measurements and the use of many different types of machine and testing methods.



Instant visual picture of waveform content is given.

In addition to presenting data graphically, one of the new features of the instrument is the optional companion recorder which may be added to make a permanent record of waveform content over extended periods. Tuning controls allow the selection of narrowed bands within the frequency range for detailed analysis. Time of scan is 1 sec, which is automatically slowed to 10 sec, 2 min or 16 min for recording purposes. (218)

Testing a car's stiffness before it sees the road

The automotive engineer must rely heavily on experience and engineering knowledge to design the required stiffness into a car structure. However, verification of a design as it comes from the drawing board can only be established after exhaustive laboratory tests of individual components, and of the complete car structure.

Early detection in the laboratory of structural deficiencies contributes greatly to sound economic planning. Laboratory testing in the automobile industry has developed to a high degree of excellence.

Details are given here of two laboratory tests for stiffness that were described by G. J. Engelhard (of **Chevrolet)** in a recent SAE paper.

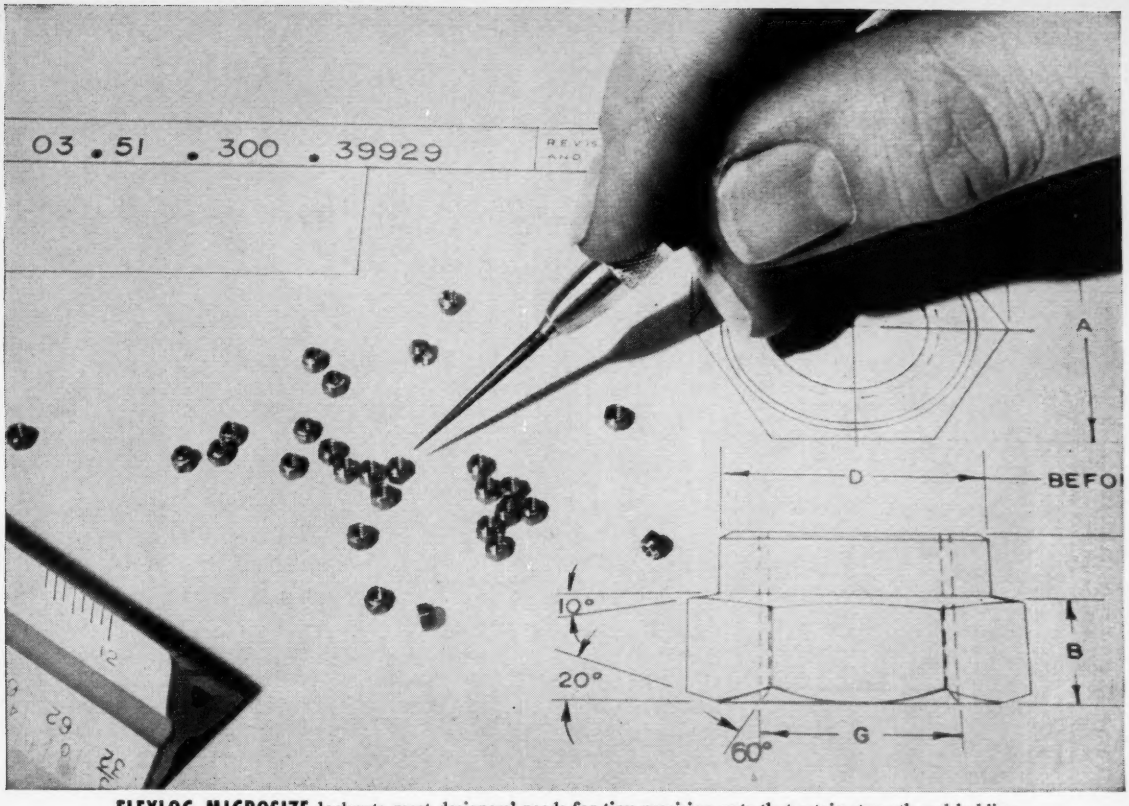
Door lateral stiffness is checked in a ring, to discover low seal-pressure areas that might admit water, dust and drafts, and cause wind noises.

A typical problem can arise when space and styling restrictions result in comparatively thin cross-sections in the door pillars at the bottom of the window area. This in turn can cause the entire upper door area to deflect outward about a breakpoint just above the belt line when the door is closed against the seal pressure.

In this test, the door is supported at the hinges and at the door lock location. A lateral load resembling the seal pressure is applied to the top of the door in the ring. Deflections are measured around the door periphery and plotted to determine the deflection contour (Fig. 2). The sudden break in the upper curve indicates poor stiffness distribution. The lower curve shows the increased stiffness and more uniform distribution that resulted from the addition of reinforcement.

Stiffness of the body centre pillar is checked by mounting it at simulated body supports, and loading it in the direction of the door slam. Although a centre

Continued on page 78



FLEXLOC MICROSIZE locknuts meet designers' needs for tiny precision nuts that retain strength and holding power in the smallest assemblies—servomechanisms, electronic and electrical equipment, all miniature devices.

New FLEXLOC Microsize Locknuts

Now available in Alloy Steel, Stainless Steel, Brass and Aluminum for lighter, more compact designs

SIZE	Across Flats		Hex. Height	Across Corners	Height
	MAX.	MIN.	REF.	MIN.	REF.
0-80 NF-3B	.111	.107	.046	.121	.075
1-64 NC-3B	.127	.123	.056	.140	.090
1-72 NF-3B	.127	.123	.056	.140	.090
2-56 NC-3B	.158	.153	.067	.176	.105
2-64 NF-3B	.158	.153	.067	.176	.105
3-48 NC-3B	.190	.183	.071	.210	.120
3-56 NF-3B	.190	.183	.071	.210	.120
4-40 NC-3B	.190	.183	.071	.210	.120
4-48 NF-3B	.190	.183	.071	.210	.120

SPECIFICATIONS: Available in brass (plain or cadmium plated) and aluminum (plain or chemically treated), for temperatures to 250°F; in alloy steel (plain or cadmium plated) and 18-8 stainless steel (silver plated) for temperatures to 550°F.

New FLEXLOC Microsize locknuts are smaller and lighter than regular FLEXLOCS of the same nominal diameter. Wrenches of smaller size are used to install them. Mating joints or flanges can be designed smaller—with no loss in strength or convenience of assembly.

Microsize FLEXLOCS have all the advantages of larger FLEXLOCS. One-piece, all-metal construction—nothing to put together, come apart, lose or forget. Use them as lock or stop nuts—they stay put anywhere on a threaded member as soon as the locking threads are fully engaged. Uniform locking torques insure accurate preloading. There are no nonmetallic inserts to pop out or deteriorate. Moisture, dryness, oil won't affect these Microsize FLEXLOCS. Just screw them on. They lock and stay locked. Vibration won't shake them loose.

For complete information on Microsize FLEXLOCS, consult your authorized distributor. Or write:

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pillar might have a reduced section at the belt (because of exterior styling and interior space requirements), it must still have sufficient stiffness to produce a solid thud, without objectionable flutter, when the door is slammed. Uniform stiffness distribution at the belt is instrumental in eliminating flutter.

Pillar test curves enable the engineer to isolate and correct a localized deflection area by adding a reinforcement or additional welds (Fig. 1). Acceptability of these changes is verified later on a road test car. (219)

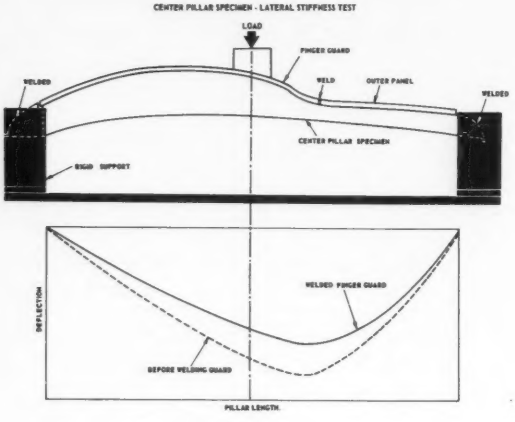


Figure 1.

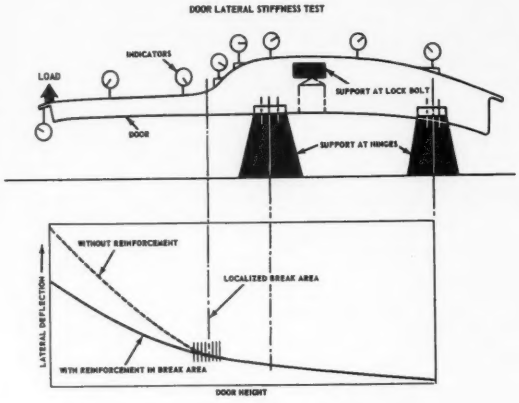


Figure 2.

Pump that permits precise control at any delivery rate

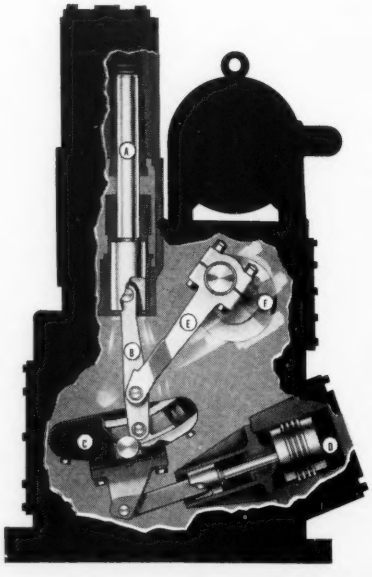
When fractional demands or variable rates of delivery are required, the variable stroke reciprocating pump has the advantages of high mechanical efficiency, low power cost and full automatic control.

The design and performance characteristics of these pumps permit efficient operation and precise control at any rate of delivery from 0 to 100%. This is because the stroke (and thus the output) of the pump can be varied without changing the speed of the prime-mover.

In effect, they combine the desirable features of both centrifugal and reciprocating pumps. For medium- and high-pressure pumping, conventional reciprocating pumps offer positive displacement and superior efficiency, but lack the flexibility of capacity and constant pressure of the centrifugal pump. The variable stroke design incorporates in one pump all the desirable characteristics.

The diagram shows a cross-section through one of three identical cylinders of the **Aldrich-Groff** controllable capacity pump. It shows the simple mechanical principles incorporated in the design of these units.

The lower end of each pump plunger (A) is connected to a crosshead and through a crosshead pin to a link (B). The link is connected to a bronze guide block which slides in a curved track on the stroke-transformer (C). This is supported on two end trunnions to permit tilting to vary the length of stroke which is accomplished automatically by means of the adjustment cylinder (D) (or by a manually operated screw mechanism). In operation, a pendular motion is imparted to the link by the connecting rod (E) operated by the crankshaft (F).



The motion of the plunger is variable from zero to maximum stroke, depending upon the angular positioning of the stroke-transformer. The delivery of the pump is thus infinitely controllable from zero to the rated maximum output. (220)

Society Column

Society for Nondestructive Testing, Inc.

The Ontario Section held a dinner meeting at the Cloverleaf Hotel, Toronto, at which the subject of ultrasonic resonance testing for thickness gauging and flaw detection was discussed by Peter K. Bloch, vice-president of Branson Instruments.

American Society of Mechanical Engineers.

A new group, to deal with the increasingly complex engineering problems encountered in keeping industrial equipment in operating condition, has been formed by the ASME. The unit will cover such topics as modification of equipment and facilities to reduce or eliminate maintenance problems.

An unusual feature of the June 9-14 meeting (in San Francisco) will be a four-part symposium on Biotechnology, the study of operation of the human body as an engineering problem. Taking part in the sessions will be engineers, medical men and experts on the adaptability of the body to such extreme conditions as thermal flight. This involves travel at such high speeds that friction between the aircraft and the atmosphere sharply raises the temperature.

Standards Engineers Society

At the May meeting of the Hamilton-Toronto Section, the guest speaker was R. M. Gooderham, Director, Canadian Welding Bureau; his subject "Canadian welding standards."

American Society of Tool Engineers

The availability of the Silver Anniversary edition of their annual collected technical papers has been announced by the Society. This includes two complete symposia, embracing twelve papers each, on ceramic tooling and plastic tooling. Also covered are revolutionary processes in rolling techniques, recent tool design advances, the conception and development of JIC standards and the management-tool engineer team.

American Society for Testing Materials.

The subject for the sixth Gillett Memorial Lecture to be given at the 60th annual meeting of the ASTM in Atlantic City on June 18 will be a perspective of molybdenum base alloys. The lecturer will be Alvin J. Herzig, president of The Climax Molybdenum Co. of Michigan. The lecture will include details of a furnace that has been used to obtain aggregates of molybdenum by melting, rather than by the powdered metallurgy process.

Tap design

(Continued from page 49)

Further to eliminate pick up (and to aid in the retention of a film of cutting oil on the taps) they were steam blackened as a final operation. This not only behaved as expected, but proved an excellent anti-rust for the taps while in storage.

The taps resulting from the above treatment are extremely satisfactory in service and show what can be accomplished by reviewing accepted engineering practices. In at least one case it increased a company's tap business over 1,100% in four years.

Except where it is desirable to have all the bearing surface possible for screws that are to be adjusted frequently, it is a costly practice to tap a greater thread depth than necessary. Much tap breakage and many cases of production difficulty may be traced to the selection of tap drills that are too small.

A common nut drilled so that it contains 50% of a full thread will break the bolt before it will strip and a full depth of thread in a common nut is only about 5% stronger than a 75% depth of thread, yet it requires three times the power to tap. On the average, a 75% thread in a nut is stronger than the tensile strength of the screw and this is the amount that is recommended for most applications. For small screws in deep holes, less thread depth will give ample strength. It should also be noted that a drill will cut a hole somewhat larger than its nominal size. This must be taken into account when percent thread depth is a critical factor.

Operating speeds

Best operating speeds for taps are more difficult to tabulate than for other types of cutting tool. With most tools the feed per revolution of the tool or work can be varied independently as conditions demand. Taps however must always advance through the work at a rate equal to one lead per revolution.

The style of tap used varies conditions greatly. For example, with a bottoming tap the first lead of each land cuts the full depth of thread, while with a taper or starting tap, a number of threads do their share of the work before a full thread is reached. The depth of thread also varies with pitch. For example, 1 in. - 8; vs. 1 in. - 27, the depth of thread being much greater in the former.

Further, it is evident that the coarser the thread, the greater the advance per revolution and consequently the greater the amount of material removed. ★

New products & materials

Packing

A packing developed during the last war for the specific purpose of packing the tail assemblies of guided missiles (V-bombs) is now being handled in Canada by **Dompac Company Ltd.** Known as Pampus packing, it will stand up under high temperatures and considerable friction. It can be formed plastically and is homogeneous. It stops all leakage, whether used with cold water or superheated steam up to 1200F, oils, alcohols or solvent acids.

It is a packing that is electrically produced from pure carbon-graphite, containing no metallic or fibre inclusions. (221)

Baking enamel

A new urea formaldehyde resin for white baking enamel formulations (called Uformite F-222) is announced by **Rohm & Haas Company.** Advantages the new resin offers formulators (according to the manufacturer) included the unusual combination of improved gloss with accelerated baking speed, as well as improved hardness, adhesion to non-drying alkyds and resistance to food stains and water.

Enamels made with the resin are said to be particularly well suited for use on kitchen cabinets, refrigerators, hospital equipment and steel furniture. (222)

Nozzle parts

Boring and contouring the inside diameters of parts for jet engine fuel nozzles is achieved by their Style 308 precision cam boring machine, according to **Ex-Cell-O Corporation.**

Clamped in three jaws, pneumatically operated diaphragm chucks, two steel parts are machined simultaneously at a production rate of 148 pieces an hour. The completely automatic work cycle is controlled by two precision cams within the base of the machine. Actuating the table and cross slide of the unit, the cams initiate and regulate all machining operations.

After chamfering the inside diameters, the boring tools enter the workpieces and bore the ID to a depth of 7/16 in. At this point, co-ordinated movements by the table and cross slide generate a 0.093-in. radius and develop a 37-deg tangent angle. The bottoms of the parts are then straight bored to provide a 0.340 to 0.343-in. hole. (223)

Meter-relays

Contact meter-relays, versatile instruments that indicate and control almost any physcial or chemical condition that can be detected electrically, are described in a new catalogue (No. 4-C) now available from **Assembly Products, Inc.**

The catalogue supplies complete information for ordering meter-relays intended for use in original equipment or in self-contained control packages. Various circuits for providing different types of control action are discussed. Also included in the catalogue are API panel meters and auxiliary components. (234)

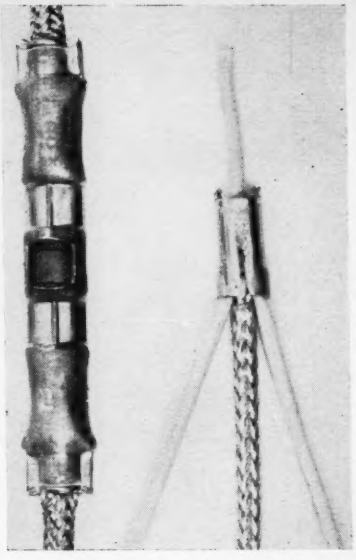
Wire splice

The new range of shielded wire splices and ferrules made by **AMP Incorporated** could be the answer to faster, more compact splicing.

The splice (between two shielded wires) is made by crimping the connector on the end of each wire with a hand crimping tool or appropriate power tooling.

Color coding of both the connector and tooling assures correct match of wire, splice and tooling. Splices and ferrules are color coded to follow RETMA standards.

A rectangular centre window in the conector assures positive wire depth in the barrel and inspection ports at each end provide definite braid enclosure.



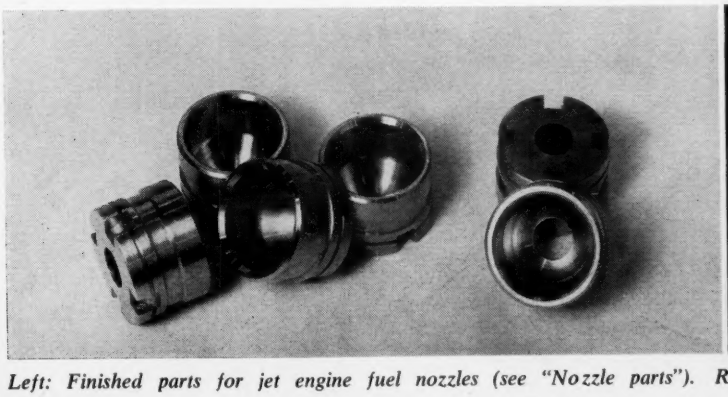
The splice is made by crimping the connector on the end of each wire.

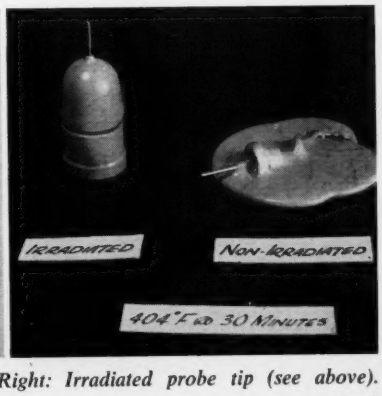
Both splices and ferrules feature one-piece construction. There are no loose pieces required to make the connection, thus bringing application time and costs to a minimum. (225)

Irradiated polyethylene

A switch has been made (by **Hewlett-Packard Co.**) from polystyrene to irradiated polyethylene for the production of high-frequency vacuum tube voltmeter probe tips. The switch was made to enable the tips to withstand cracking at low temperatures due to the different rates of expansion of the embedded electronic components. This low-temperature stress cracking exposed the internal parts to moisture and was the major limitation of the polystyrene material.

Polyethylene eliminates the low-temperature cracking problem. The tendency of conventional polyethylene to flow at high temperatures, however, restricted its use under high ambient conditions and in applications where the probe tips are soldered directly into the electronic circuits under test. (226)





Left: Finished parts for jet engine fuel nozzles (see "Nozzle parts"). Right: Irradiated probe tip (see above).

Continued on page 88

Book Department

Automation in Business and Industry edited by Eugene M. Grabbe (John Wiley & Sons, Inc.). The book is based on a series of lectures given by prominent engineers and scientists at the University of California. It supplies a wealth of information and detail on the fundamentals of automation, new developments in automation techniques and descriptions of automation system applications.

The work shows how the fields of feedback control theory, instrumentation, analog and digital computation and data processing are now becoming integrated, as automation is applied on a broad scale to control systems that encompass the range from top management to individual machines.

Bearing Design and Application by Donald F. Wilcock and E. Richard Booser (McGraw-Hill). This is a practical guidebook for the machine designer to help him select and design bearings. It lays emphasis on the selection and calculation methods for integrating the bearing design, bearing material and lubricant into a workable unit.

Among the subjects covered are: analysis of load capacity, speed, temperature, dimensional tolerance and lubrication factors in selecting ball and roller bearings; reciprocating bearing design methods for automotive and diesel use; lubrication system design. One important feature of the book is the coverage given to systematic trouble-shooting techniques for analyzing and eliminating difficulties.

The book contains explicit equations for design procedure and many numerical examples.

System Engineering. An introduction to the design of large-scale systems. By Harry H. Goode and Robt. E. Machol (McGraw-Hill Co. of Canada Ltd.). The book gives an over-all view of the relatively new "system design" approach to the problem of designing engineering equipment. It assumes a mathematical background of elementary calculus.

The book shows how a number of very important fields (such as statistics, computers, information theory, servo mechanisms and control) are put together by a group of system engineers to attack large-scale problems in engineering, as, for example, the development of radar systems, telephone systems or guided missile systems.

The purpose has been to provide the engineer (who hopes to be a member of a system-design team) with sufficient technical background for this work.

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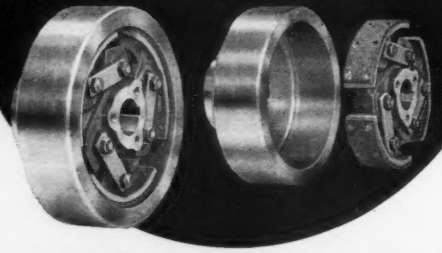

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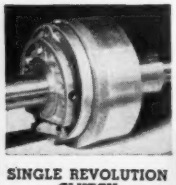

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Write for Bulletin 239.

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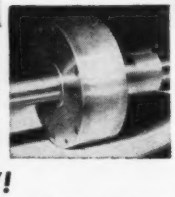
Write for Bulletin 231.



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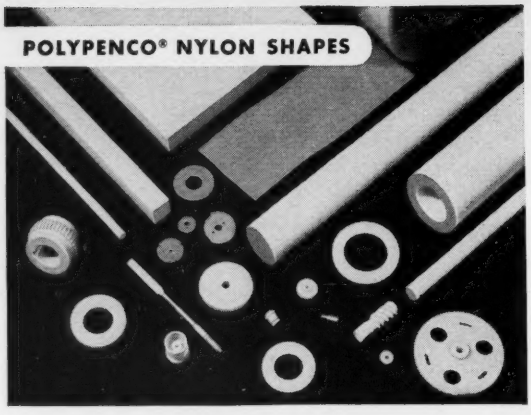

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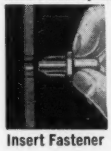
POLYPENCO

This fastener works through thick and thin!

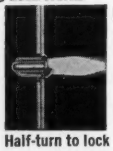
Spring-Lock works whether panel thicknesses run over or under specifications. Spring wire deflects automatically to handle greater or lesser thicknesses. Made in all-metal and plastic with steel insert, it can be adapted as a shelf-support, washer knob, bracket or any similar panel-mounted device.

Write for 40-page catalog on complete line, containing application examples, specifications, installation instructions and engineering data. Ask for samples, too.

Here's how Spring-Lock Works



Insert Fastener



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- **QUICK:** Half-turn locks it in place
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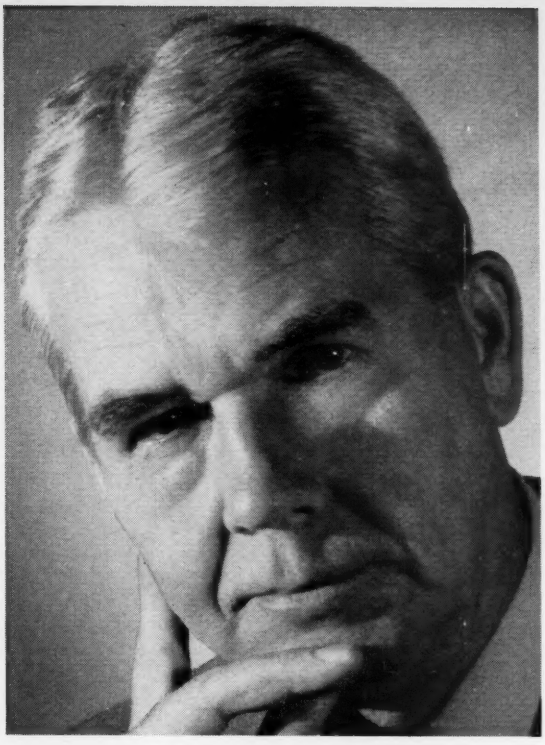

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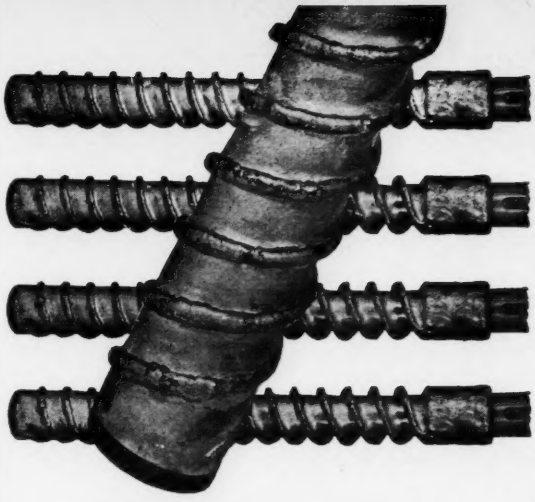
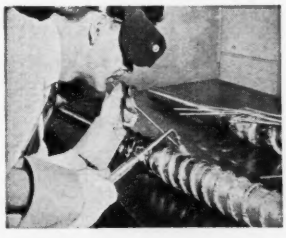


Colmonoy INCREASES Extrusion Screw Life

Tests revealed a tremendous increase in the service life of these Colmonoy hard-faced extrusion screws, as against the unprotected screws usually used. Orders for new replacements now specify Colmonoy hard-facing.

Used for extruding plastic, these screws are made of age-hardening nickel-base alloy. This alloy is now readily hard-faced with little loss of hardness, using Colmonoy No. 6 gas rod and a new Colmonoy high temperature flux.



The 60-inch screws have a .050" overlay of Colmonoy No. 6 when finish ground. Colmonoy hard-facing pays for itself in increased life very quickly on expensive parts such as these.

To provide any metal part with longer life, investigate Colmonoy alloys and methods. They represent a complete line of wear resistant alloys and the most up-to-date in hard-facing techniques.

Submit part drawings and a description of the wear encountered for a specific recommendation. Request Hard-Facing Manual No. 79.

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Letters

Readers' viewpoints . . .

Fair exchange

Our Library is very much interested in arranging regular and friendly exchange relations with your institution.

We enclose herewith a list of Soviet publications which we have available for exchange.

In exchange for your journal Design Engineering we can send you any of these publications.

We hope that the establishment and further development of this exchange will benefit scientific and cultural relations between the peoples of your country and the Soviet Union.

from V. M. Baraschenkov, M. E. Saltykov-Shchedrin State Public Library, Exchange section, Sadovaia 18, Leningrad-Centre, USSR.

(We did not avail ourselves of this offer. The fact that the list of publications referred to was printed in Russian may have governed our decision—Ed.)

Association of design engineers

I seem to recall reading in Design Engineering some months ago, some editorial comments on a proposal to found a Canadian Association of design engineers.

I am not clear whether these proposals have reached fruition yet, but if they have, I would much appreciate it if you would let me have the name and address of the individual to whom I should address any enquiries re membership.

from G. A. Peters, 438 Simcoe Street, London, Ontario.

(We passed on his name to James Orr, the chairman of this society—Ed.)

Pressure measurement

I am baffled by Mr. Cunard's "mathematics" ("Can pressure be measured accurately?" April 1957 issue). He says that the work done (Q) when a capsule is expanded is represented by the equation:

$$Q = J\left(\int_{P_1}^{P_2} V\,dp + \int_{V_1}^{V_2} p\,dv\right)$$

Before we can even begin to think about integrating the first differential expression in the bracket on the right of the equation, V must be expressed as some kind of a function of p (such as p^2, log p, etc.). Instead, Mr. Cunard drops this aspect of his problem with the remark: "This work can be recovered on subsequent expansion to the original pressure P."

The second term in the bracket receives, if anything, shorter shrift, for, by using a stiff capsule, we are able to regard the volume change as being practically zero. This amounts to saying that the work done in changing the volume of the capsule when the volume doesn't change is zero! What else? Mr. Cunard doesn't even seem to notice that, if the volume of the capsule doesn't change, its contained liquid or gas doesn't change in volume either. And since the change in pressure is due to change in volume, the pressure change also reduces to zero. Thus **both** integrodifferential expressions amount to zero! This is, at any rate, quite an improvement on the inconsistency of a liquid or gas **contracting** when the volume of space at its disposal is **increased.**

Finally, where does the letter J come in? J, as the conventional symbol for the mechanical equivalent of heat, would only come into the picture if mechanical energy were converted into heat (or vice versa).

But Mr. Cunard has expressly ruled out his consideration by assuming "constant temperature on expansion." Admittedly, if a gas expands and performs mechanical work in doing so, it can only be maintained at the constant temperature by being supplied at all stages with an amount of heat equivalent to the mechanical work performed at each stage. But this consideration, or its converse (abstraction of heat from a gas undergoing compression in order to maintain its temperature constant), is not involved, by Mr. Cunard's own argument, in the present discussion. Perhaps I may add that, apart from an explanatory remark prior to dismissal, J does not usually find a place in modern discussions of thermodynamics.

from Walter Wilson, Toronto.

(We await Mr. Cunard's reply.—Ed.)

Pressure measurement

We have noted, in the April issue of your magazine, a very interesting article on pressure measuring instruments. This article is outlined in red pencil on the attached card, for purposes of identification.

We would appreciate it if you could send us three extra copies of this article. If there is a charge for this service, please bill us accordingly.

from A. E. LeVan, Vice-President, Research and Engineering, United States Gauge, Sellersville, Pa.

(The three copies were duly sent.—Ed.)

New products
continued

Vibration exciter

A hydraulic vibration exciter, capable of sinusoidal motion at extremely high forces and larger strokes not obtainable with present vibration test equipment, is announced by **MB Manufacturing Co.** The first exciter system now being installed has a maximum force of 60,000 lb, an available stroke of 4 in. and a maximum velocity of 14 in. per sec in the frequency range of 1 to 150 cps. In contrast, the MB C250 electrodynamic exciter, the largest of that type now in production, has a rated force output of 25,000 lb and a stroke of ±0.25 in. over a frequency range of 5 to 500 cps.

The MB hydraulic exciter has five basic components: the driving head, a hydraulic accumulator and a high-pressure hydraulic pump, an electronically controlled servo valve and an electronic control system. (227)

Static voltmeter

A static voltmeter that provides continuous measurement of static charges is available from **Dawe Instruments Ltd.** The voltmeter (Type 635) gives both field and contact readings over a range of 0.1 to 5,000 volts. It shows the strength and location of the charges and the rate of buildup. It also measures current and insulation resistance, and indicates direct polarity.

The manufacturers say the voltmeter is already proving useful in a variety of industries, particularly in plants using chemicals and chemical preparations. They say manufacturers of fibrous materials (such as nylon, orlon or dacron) have been able to locate and measure the minute static charges on individual threads. (228)

Push buttons

Designed for accessibility of wiring, distinctive appearance and flexibility, are the new heavy-duty oil-tight push buttons available from **Davis Automatic Controls Ltd.** Rated to 550 volts a-c or d-c, the line includes push buttons, selector switches, selector push buttons, pilot lights and accessories such as mushroom head, lever and key lock. All units are built around one standard contact block. No rights or lefts. These contact blocks can be used singly or in tandem, mounted vertically or horizontally. (229)

Pyrometers

A line of small millivoltmeter pyrometers (the HP-30 series) is available from **Canadian General Electric Company Limited.**

Designed to keep pace with the trend to smallness in process instrumentation, this pyrometer uses a high-strength magnet material, printed circuits and miniature tubes and relays and thus saves 50% more panel space than pyrometers now in use.

Used primarily for temperature control, the new pyrometers can also be used to measure other process variables such as speed, vacuum, density and electrical quantities.

HP-30 pyrometers can be used in any industrial processes requiring heat, including equipment manufacturers and producers in foundry and other heat-treating operations, drying processes, plastic molding and extrusion, rubber fabrication systems and government test facilities. (230)

Zinc brightener

A zinc brightener (under the trade name of Zinc-Kote) is being introduced to the plating industry (by **Smoothex Corp.**) for improved quality barrel plating of small parts at lower cost.

When added to a bath, it produces brilliant zinc deposits on the entire surface of all the parts being plated. Time is saved and production speeded because bright plating is done directly from the bath to eliminate subsequent bright dipping.

The close-grained, thick zinc deposits that are formed assure an excellent underseal for finishes and protect the parts from rust and corrosion. A good foundation is also provided for chromate finishing and bonderizing.

Because of the wide current density range, uniform zinc deposits are made on all parts within the barrel. Plating current ranges from 60 to 90 amps per sq ft, depending upon the type of work being processed. (231)

Wiring clip

A twin U-Type Speed Clip, developed for the attachment of electrical wiring on household appliances, electronic equipment and other products, was announced today by **Dominion Fasteners Limited.**

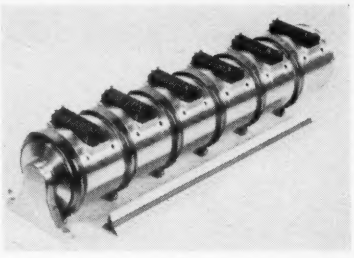
Employing Tinnerman's exclusive heel-and-toe principle of self-retention, the new clip is front-mounting and eliminates the need for nuts, bolts or auxiliary fastening devices.

Ideal for use in hard-to-reach locations, the spring steel "toe" is inserted into a mounting hole in a panel; with slight finger pressure (down and forward) the clip snaps into the wire-receiving position. Electrical wires, firmly secured by twin steel fingers, can be removed for servicing or replacement without detaching the clip. (232)

Stainless casting

A casting of special stainless steel has helped a manufacturer of papermaking equipment to lick two big problems of corrosion and erosion in the machinery that makes pulp from all species of wood.

A foundry workman makes a hardness check on a special steel feed screw.



This new device allows the stacking of twenty poles in a single switch.

The Black-Clawson Company, makers of pulp mill equipment, reported that one of their biggest problems was to get a material that would stand production conditions.

These conditions are exacting and have taken the toll of a number of metals. In making pulp, various cooking liquors are used to break down wood fibres. In addition, dirt and sand are brought in with the chips. These foreign substances act like tiny files on the equipment.

To combat the corrosion and erosion problems, the company now uses a special stainless steel, which they call Pandaloy, in the feed screws. The screws are cast at the Buffalo Foundry of Alleghany Steel Corporation. (233)

Stacking switch

With this versatile switch (developed by the **Applied Science Corporation**) it is possible to stack up to 20 poles in a single switch. The switch is comprised of sections held together by V-band clamps. The end of the shaft in one section fits integrally with the end of the shaft of the adjoining section, so no couplings are needed. Each contact plate is phasable with every other plate by a screw adjustment. Plates may be made with from one to three poles, with up to 90 contacts per pole. Various types of drive motors are available providing switch speeds up to 600 rpm. (234)

Advertising index — June

Editorial

Helping to beat the engineer shortage

A significant step has been taken by McMaster University in announcing the formation of a School of Engineering next fall. Four-year courses will be offered in chemical, electrical and mechanical engineering; there will also be courses in engineering physics and metallurgy.

President Gilmour stated that the addition of engineering studies to their educational program is a natural expansion of the scientific activities of Hamilton College. The staff and facilities in physical sciences have grown rapidly since the war and will provide the firm foundation of basic science and mathematics so necessary in a modern engineering curriculum.

It is planned to enroll only 50 first year students in September but when the school is functioning to capacity, it will have an enrollment of five or six hundred students. The fact that the faculty is so close to many big steel, electrical, chemical and other industrial enterprises will be in its favor.

The courses and facilities for the school have been planned by Dr. John W. Hodgins, the new Director of Engineering Studies. He stated that an opportunity has been presented to plan curricula and buildings in accordance with present-day trends and knowledge and with the best forecast of future developments in science and engineering. Future engineers must be particularly well educated in fundamental science and mathematics and must be prepared to meet new and unfamiliar situations with imagination and competence. He stated that time will be allocated throughout the entire course for the analysis of new problems and for original design work based upon these analyses.

Since the activities of engineers are having an ever-increasing impact upon society and since, also, the current shortage of engineers has the effect of allowing recent graduates to move rather quickly into positions of responsibility, it is appropriate that about one fifth of the course should consist of the humanities and social studies.

Congratulations!

The organizers of two Shows held last month can justly be proud of their efforts.

One of these was the Design Engineering Show held at the Coliseum, New York. The attendance broke all records but the number of Canadians present—as far as we were able to ascertain—was still disappointing, but still better than the 19 or so who were there last year!

This Show has certainly rocketed to stardom in the two years of its existence, a sure indication of the big part played by the design engineer today.

Nearer home was the Industrial Tool and Production Show, held in Toronto for the first time, a visit to which we found well worth while. It is sincerely hoped that as a result of its success the Tool Show will become an annual event.

William Morse.

SKF

50th Anniversary

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LIMITED

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DISTRICT OFFICES COAST TO COAST

How high load capacity is built into less space in Dodge-TIMKEN All-Steel pillow block

THIS rugged Dodge-Timken pillow block packs more capacity in less space than ever before. All-steel construction gives it extra strength and durability. The design is compact. No special thrust devices that take up extra space are needed—the two-row Timken tapered roller bearing takes *both* radial and thrust loads in any combination. And full line contact between the rollers and races assures high load capacity.

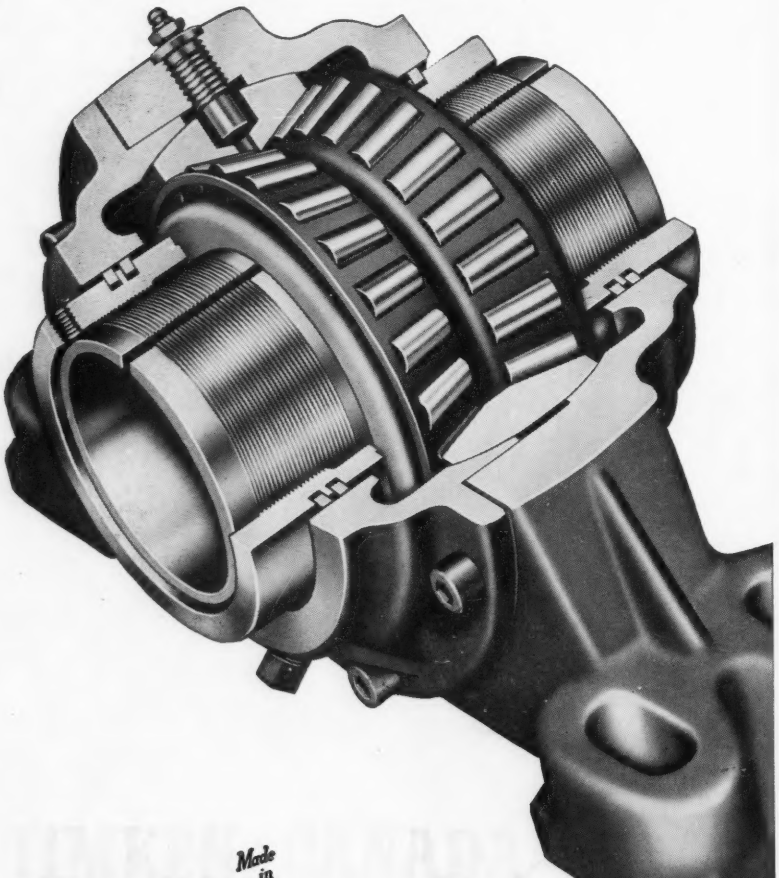
The cutaway view below shows the bearing. It is of special design, with tapered bore and self-aligning spherical outer surface—never requires adjustment. As in all Timken bearings, races and rollers are case-carburized and have tough, shock-resistant cores under hard, wear-resistant surfaces. Under normal conditions, the Timken bearing will last the life of the machinery with which the pillow block is used.

In addition to the all-steel pillow block shown here, Timken bearings are also used in the Type "E", Double-Interlock, Type "C", and Special-Duty pillow blocks—other versatile pillow blocks in the Dodge-Timken line with a wide variety of uses in industry.

To be sure of the finest bearing steel, we make our own. No other bearings can give you all the advantages you get with Timken bearings. Include them in your design plans . . . specify them for the machines you buy or build. Look for the trade-mark "Timken"—it's on the bearing that makes any machine run better. The Timken Roller Bearing Company, Canton 6, Ohio, U.S.A. **CANADIAN PLANT:** St. Thomas, Ontario. Cable: "TIMROSCO".

TIMKEN BEARING EQUIPPED

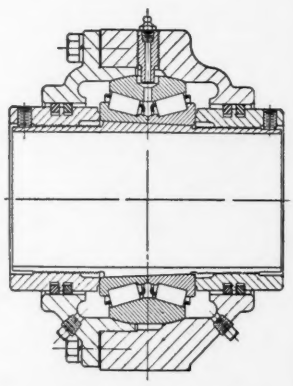
This symbol on a product means its bearings are the best.



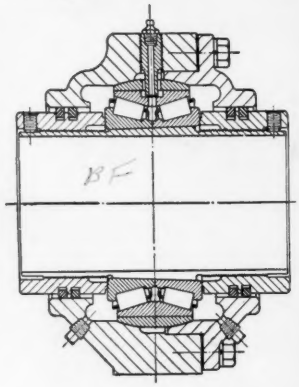
Made in

TAPERED ROLLER BEARINGS

FOR CANADIAN INDUSTRY



How **DODGE MANUFACTURING CORPORATION,** Mishawaka, Ind., U.S.A., mounts Timken bearings in the Dodge-Timken All-Steel pillow block. Above: non-expansion block with fixed bearing. Below: expansion block with floating bearing.



NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION